BROOKLYN BOTANIC GARDEN

PLANTS & GARDENS

BROOKLYN BOTANIC GARDEN RECORD

PLANTS & GARDENS

HANDBOOK ON FERNS

How to Grow
and Use Ferns
- in the Garden
- Indoors

Growing Ferns
from Spores

43 Useful Ferns

Constructing a
Fern Cobble

Places Where
Ferns Grow
- in the Wild
- in Preservations

Ferns in
Literature

SPRING
1969

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VOL. 25 NO. 1

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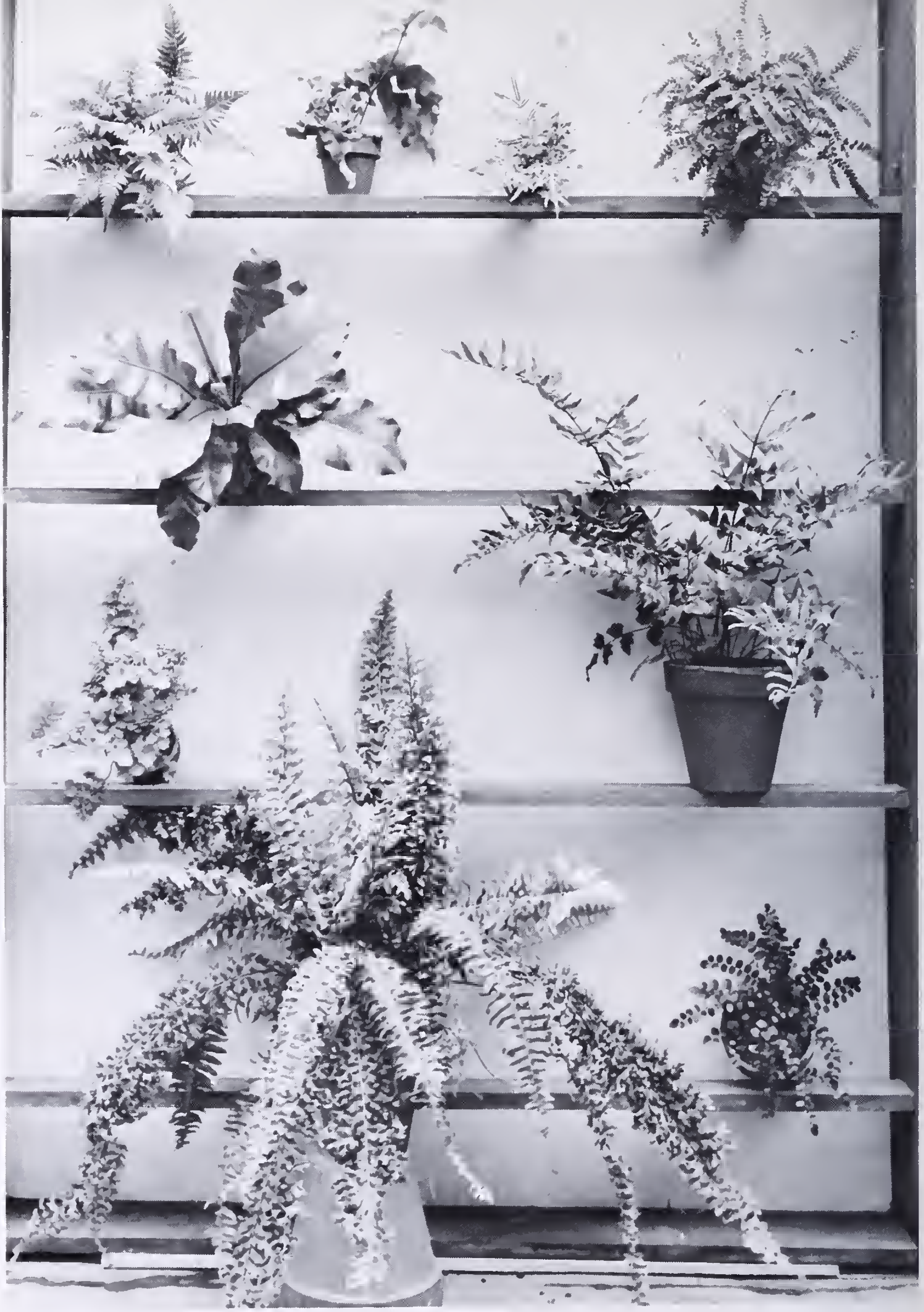


Roche

Inspiration for a fern collector: (top row from left to right) *Polystichum tsus-simense, Polypodium aureum, Pteris ensiformis* 'Victoriae', *Adiantum hispidulum;* (second row) *Asplenium nidus;* (third row) *Adiantum decorum* 'Pacific Maid', *Pteris* 'Adiantoides'; (bottom row) *Nephrolepis exaltata* 'Hillii', *Pellaea rotundifolia.*

BROOKLYN BOTANIC GARDEN

Almost everyone with an interest in gardens want to know more about ferns—yet not too much. This Handbook attempts to answer such a need.

In the world there are some 6,000 different species of ferns that grow in the wild between the Arctic (or the Antarctic) and the equator—and they belong in about 150 different groups (genera). While most ferns thrive in the soil of moist woodlands on the floor of the forest, there are also species that live in the water or high up on trees (epiphytes). Some are vines that twine their way up the trunks of trees. And some, indeed, are trees: these are the progeny of ancient tree ferns that once made up the forests of the coal age and now are to be found living in the mild climates of New Zealand and the tropics. Although most ferns are compartively small, they are by no means a family of weaklings. They have inhabited the earth since the Paleozoic Era—the time of the dinosaurs—when they or their close relatives were the dominant vegetative cloak of the earth.

For a moment, consider just one fern, the common polypody of Europe, Asia and North America. It is a versatile creeper and its scaly rhizome adapts to many situations: it grows on old walls, clambers over rocks in the woods, and clings high up on the bark of old trees.

So much for ferns in nature, except for the reproductive cycle. The diagram on page 44 tells the story. The significant point for anyone with the leanings of a naturalist is that there are really two distinctly different plants in the life of every fern. They are, in fact, often called "generations." The plant of the sexual generation looks much the same in all species. It is small, often heart-shaped and fragile, but above all it is green. This means that, with light, photosynthesis is possible and that this thin leaf-like structure, called a prothallium, can manufacture its own food and be independent. The organs that produce the sex cells develop on the lower surface of this prothallium. At a certain stage, a drop of rain or adequate soil moisture is all that is needed to enable the sperm to swim to the egg. Once fertilized, the egg grows into the familiar fern we know and name. This plant is the spore-bearing generation. Any one of the thousands of single-celled spores that a sporophyte produces will, if it falls into a moist and favorable spot for growth, grow into the prothallium of the sexual generation, thus completing the fern's cycle of life.

Most important for readers are the articles that Guest Editor Helen S. Hull has invited authors to contribute. There are ferns for many purposes and situations, from the living room to a shaded corner of the garden.

George S. Avery

Director

BEAUTY IN GREEN

Helen S. Hull

FERNS, which in their genes may hold secrets of this planet Earth millions of years before man walked upon it, mystify and intrigue us with their form and grace. Growing all around the globe in tropical and temperate regions, they range in size from a fraction of an inch to towering palm-like trees which grow in tropical rain forests.

In our eastern woods, they vary in the color and texture of their leaves from the transparent chartreuse silk of the maidenhair fern to the dark leathery fronds of the common Christmas fern. The strap-like hart's tongue fern and the fine green

Roche

Ferns in the Hull garden. *Above,* broad beech fern with foam-flower; *right,* interrupted fern in sunlight at foot of oak tree; *left, top,* marginal wood fern; *left, bottom,* cinnamon fiddleheads by brook.

lace of lady fern are evidence of the diversity in leaf designs. As uncoiling croziers in early spring, they are spectacular.

Ferns evoke memories of walks in cool glens, brushing through fragrance shoulder high; of shady rocks draped in polypody or embellished with medallions of maidenhair spleenwort, or a tangle of walking fern said to be on a march around the world. Although the subject of ferns is a vast one, our aim here has been to share ways to enjoy their green beauty in gardens, homes, and places where they are native. ◆

THE GARDEN USE OF FERNS

F. Gordon Foster

WHETHER YOUR GARDEN is a small suburban plot or woodland acreage in the country, your planning, effort, and care will determine whether your ferns will thrive or merely exist. Some kinds require little or no care; others are virtually impossible to grow under any garden conditions. Regardless of the size of the garden, the real thrill comes in seeing the uncurling croziers of early spring, and this pleasure continues as the leaves develop.

For best results study a group of ferns and learn their characteristics and growth habits. There will be places needing tall ferns as foundation plantings or as transitionals between garden and woodland. Medium-sized ferns can be used in a mixed planting with shrubs and flowers. The miniatures adapt themselves readily in the rock garden.

Soil, light and moisture are the requisites in making a fern garden. Most ferns need a soil light in texture, like natural woodland leafmold or a mixture prepared from topsoil, humus, peat moss and sand. Generally the soil should have a neutral or slightly acid reaction. Where a deeply mulched soil is used, sufficient moisture will be retained for several days during dry weather. For the best results, ferns should be watered about as often as a well-kept lawn.

Ferns are primarily shade-loving plants and should not be subjected to long periods of direct sunlight. The northern side of a building or areas under trees where filtered sunlight will reach them make good planting areas. It is almost impossible to grow ferns in the full shade of a dense pine grove.

Here are a few suggestions for the gardener with a small suburban plot:

Among the osmundas, royal fern, *Osmunda regalis*; cinnamon fern, *O. cinnamomea*; and the interrupted fern, *O. claytoniana*, are large ferns that are easily grown. They are at home in damp, acid soil, so plan accordingly for best results. Against high foundations or old-fashioned porches these plants can do much to lower architectural lines. Placed in front of older rhododendron and laurel plants, they conceal the unsightly, leggy undergrowth. Since they are large, allow at least 3 feet between plants.

I like the many shield ferns. These plants grow from crown-like rhizomes, a desirable feature which prevents their spreading too rapidly. When planting, do not crowd them. For ultimate beauty it is best to allow at least 2 feet between them. These plants are native among rocks; placing them beside a large rock or rotting log not only enhances their appearance but provides protection from wind and stray animals.

My first choice in the shield-fern group is the marginal shield fern, *Dryopteris marginalis*, a strong, deeply veined evergreen species. Spinulose and intermediate shield ferns, *D. spinulosa* and *D. intermedia*, are evergreen where the winters are not too severe. Plant them in deeply mulched spots; adding a few small stones in the mulch will simulate their native haunts.

Christmas fern, *Polystichum acrostichoides*, is one of our best hardy evergreen species. Each spring its tightly wound, silvery-scaled croziers rise amid the prostrate but still green leaves of last year. The new leaves grow so fast that they appear wilted for the first few days. Each little boot-like pinna has spiny tips along its edges.

Find a place for the common or Northeastern maidenhair, *Adiantum pedatum*. It is one of our prettiest ferns and, with reasonable care, will do well in a small garden. Here again a deeply mulched spot or a bushel-sized hole filled with well-aged compost will allow it to spread its root system. With constantly moist soil and filtered sunlight, this fern soon makes a delightful stand. For

Royal fern, *Osmunda regalis*, requires soil conditions similar to those of most broadleaved evergreens. In a mixed foundation planting, a graceful clump effectively contrasts with pieris foliage.

Roche

The lacy but exceptionally vigorous hay-scented fern *(Dennstaedtia punctilobula)* will thrive in a sunny location. It should be set where its invasiveness can be controlled.

charm, plant it among the soft foliage of bleeding-heart or similar flowering plants.

Fragile bladder fern, *Cystopteris fragilis,* will grow readily between two large stones. The little emerald-green croziers of this fern are generally the first up in the spring, sometimes only to be covered by a late snow.

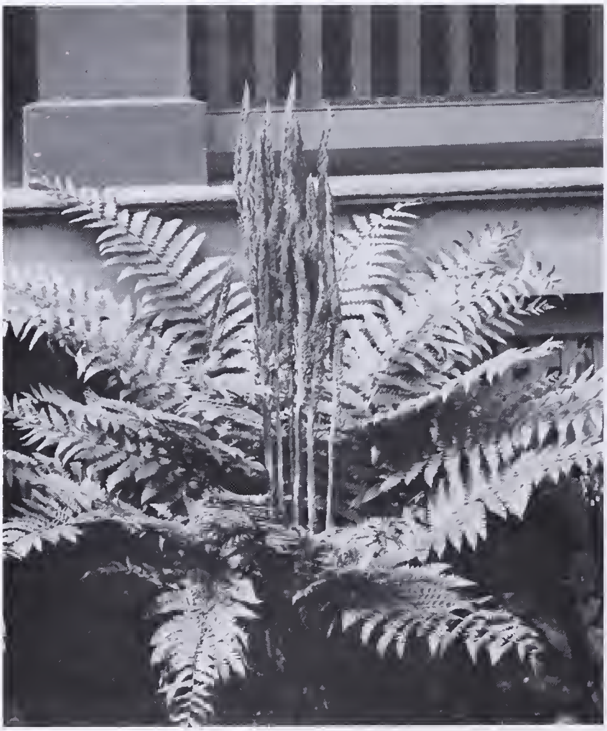
In adding ferns, stop before your garden is crowded. Well-chosen and well-grown clumps will show up to best advantage if not jumbled together.

For fern lovers with large woodland gardens there are many more available species to choose among. Of course planting a large garden will require even greater thought than a small woodland area or a suburban plot. A map showing the location of the paths, big trees and boulders should be made first to avoid a hodge-podge and save many later changes.

Ostrich fern, *Matteuccia pensylvanica,* a large vase-like plant, is excellent for very damp or marshy areas of large woodland gardens. The root system is unique: crown-type rhizomes arise at intervals from a strong underground mass of stolons. This root pattern is excellent for retaining soil along the banks of a brook. Once established, this fern grows rapidly, so it should be used only in a large garden. Ostrich fern has dimorphic leaves—its large, early rising, sterile leaves are followed in June by short, narrow but lasting fertile leaves that emerge from the center of the crown.

Lady fern, *Athyrium filix-femina,* has long been the favorite of the poets. It has many varieties, including one with a red petiole. All will form dense patches of beautiful lacy leaves. Although deciduous, it will continue to send up croziers until overtaken by frost.

Some fern lovers frown on having the invasive hay-scented fern, *Dennstaedtia punctilobula,* and sensitive fern, *Onoclea sensibilis,* in their gardens. I like them both, provided they are planted in proper places. To preclude spreading, they should be placed between natural boundaries. Sensitive fern is exceptionally



Roche

The strong-growing cinnamon fern *(Osmunda cinnamomea)* can be a distinctive accent in a home garden setting. Here it helps to camouflage the high foundation and porch of a turn-of-the-century dwelling.

affected by changes in temperature, turning brown during a very cool night in early spring or fall. Its leaves are dimorphic and the fertile "bead sticks" are always interesting. Leaves of the hay-scented fern are lacy and long-lasting when used in a floral arrangement.

For a damp limestone ridge, try the bulblet bladder fern, *Cystopteris bulbifera.* Its long tapering leaves will flow gracefully over the stone. In addition to reproducing by spores, this fern also propagates by means of pea-sized bulblets on the underside of the leaves.

Look for the different grape ferns of the genus *Botrychium* that might already be growing in your wooded area. Rattlesnake fern, *B. virginianum,* and the daisy-leaf grape fern, *B. matricariaefolium,* appear early in April. Lacy-leaf grape fern, *B. dissectum,* and leathery-leaf grape fern, *B. multifidum,* come up in late July or early August and are evergreen. I have often found this year's new rattlesnake fern growing alongside of last year's still green lacy-leaf grape fern. These ferns require a fungal relationship with the soil in which they are found in nature and cannot be grown in other types of soil. To move a grape fern with a large clump of soil is futile, as the life-giving organisms are soon leached from the old soil by the ground water.

In thicket-covered areas search for the ebony spleenwort, *Asplenium platyneuron.* In many ways it looks like a miniature Christmas fern, although there is no generic relationship. It is easy to transplant and prefers a somewhat drier location than most ferns.

Propagating Ferns

Fern propagation, with its many different approaches, is an interesting phase of fern gardening. You can try spore growing, rhizome sectioning, leaf budding, and bulblet growing.

Rhizome division is the easiest, quickest and surest way to propagate ferns. Study the rhizome–root system first. Some species, for example the hay-scented fern, New York fern and beech

Roche

The lady fern (*Athyrium felix-femina*) is a graceful fern, suitable in gardens for colonizing, or featuring as a specimen beside shaded steps or at the end of a pool.

ferns, form dense mats which can be separated with a sharp knife. Quickly replant the divided mats at the same depth as the original stock.

Shield ferns and Christmas fern grow crown-like terminals of their rhizomes. In time, new crowns will form on the side of the old stock. Carefully remove by means of a serrated knife, using a cutting-sawing action. Shield ferns and Christmas fern have very shallow root systems which must be put at the correct depth.

Vegetative budding takes place on the terminals of the long tapering leaves of the walking fern. Here a new plant starts to grow at the tip of the mature leaf and begins an independent life. Do not sever the new plant from its parent until it has established a firm foothold. Then cut off the tip of the old leaf with its attached plantlet and pot on the surface of moist vermiculite. Transfer to growing soil when roots have developed.

Try propagating the little bulblets from the bladder fern. For this method, remove the pea-like bulblets from the underside of the leaf in early July. Gather only the large ones and stratify them by storing in a plastic bag in the refrigerator at about 40° F. for three months. These may be planted on a sterilized sphagnum-humus surface in a growing dish such as is recommended for sowing spores. Your "fern farm" from bulblets should show signs of life in about three months.

As you become acquainted with native ferns, you will want to add others. And then there are the many interesting hardy exotics and horticultural variants that seem to have no end, not to mention the numerous tender ferns that must be grown under shelter in all but a few regions. ◆

For more photographs of ferns in garden settings, see pages 37-39.

Roche

Set between a flagstone paving and a stone foundation, maidenhair (*Adiantum pedatum*) responds to the compost-rich soil, which remains cool and moist.

GROWING FERNS INDOORS

Ernesta D. Ballard

THERE is a vast number of tropical ferns. Because of their minimal requirements and general tolerance of unfavorable conditions, they were among the earliest plants grown in houses and conservatories. The popularity of ferns as house plants reached a peak in the Victorian era. An English catalogue, published about 1912, lists "upwards of 2000" species and varieties of "Stove, Greenhouse, Hardy, Exotic, British and Filmy Ferns and Selaginellas"! An American catalogue of the same period pictures eight varieties of *Nephrolepis*, the Boston fern, including one which had been awarded medals by six horticultural societies, four other organizations and the St. Louis World's Fair.

Since those heady days, the tropical ferns have lost ground in popularity, but not in amenability to indoor gardening. They are still among the easiest and most satisfactory plants to grow in the house, and I recommend a number of them without reservation.

Types of Tropical Ferns and Their Environment

In general, tropical ferns are to be found in rain forests and jungles. Some are terrestrial, living in the layer of fibrous, spongy, decaying vegetable matter that carpets the forest floor. Many of these have rhizomatous stems which run along or just below the surface. In addition to supporting the fronds, the stems provide a reservoir of moisture, making the rhizomatous types quite house hardy.

Another large group of ferns is epiphytic. They grow in rock crevices or perch on the trunks and limbs of trees, deriving the moisture needed for growth from the humid jungle air. Some of these are also quite hardy in the house if the humidity can be kept reasonably high, and they lend themselves to attractive planting on slabs of cork bark, cedar, cypress or redwood, or in hanging baskets filled with sphagnum moss.

Some ferns are evergreen and some deciduous. "Evergreen" does not mean that the fronds last forever, but rather that they last more than a year in the green state or that they hang on indefinitely after they have turned brown. Often these so-called evergreen ferns have leathery fronds.

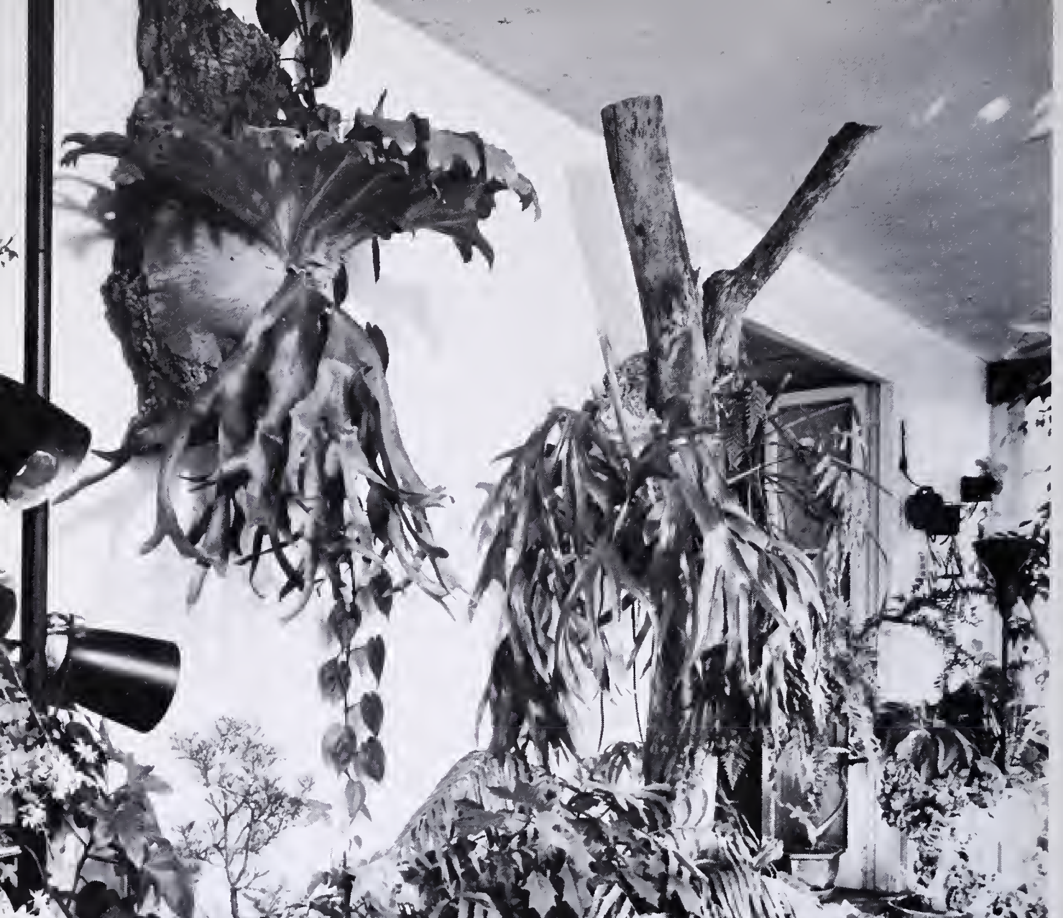
Within these general categories, ferns display an unbelievable variety of color, shape and texture, ranging from the airy lightness of the fluffy forms of *Nephrolepis* through the delicate tracery of the *Lygodium* to the bold shield of the *Platycerium*. There is no end to the decorative effects that can be achieved by careful selection and artistic arrangement.

Culture of Ferns Indoors

Like other plants that grow within the jungle, tropical ferns are classified as shade plants. This is not to say that they must be kept out of the sun altogether; in fact they will benefit by a few hours of daily sunlight during the indoor gardening season. Rather the shade classification signifies that ferns will tolerate a remarkably low level of light intensity, which makes them especially suitable for north, east and west windows, and locations some distance removed from the face of a south window.

The most important aspect of the indoor culture of ferns—and for that matter, other tropical plants—is humidity. The plants have evolved in an environment where the relative humidity generally exceeds 50 per cent. In a heated house on a cold day, the figure is often below 10 per cent. The problem for the indoor gardener is to narrow this gap.

The traditional methods of increasing humidity include placing the plants on trays of damp sand or pebbles, spraying them periodically with mist or fog, grouping them closely so that each benefits from the transpiration of the others, and



Edmund B. Gilchrist, Jr.

Three exotic epiphytic ferns: *Stenochlaena palustris* is in planter; *Platycerium grande* is on wall at left; *P. bifurcatum* (staghorn fern) is on tree trunk to the right.

installing a humidifier. All these are helpful. But I am coming more and more to the conviction that the best way to improve the growing conditions is to turn the thermostat down. There are a number of reasons why this is so.

In the first place, lower temperatures result in higher relative humidity. Cold air has less capacity to absorb water than warm air, which means that the amount of moisture present in the room (whatever it may be) will represent a higher percentage of the absorptive capacity if the room is cool than if it is hot. In addition, evaporation and transpiration are reduced at lower temperatures, so the plants do not dry out as fast. Finally, although not related to humidity, insect activity and proliferation decrease as the temperature drops, lessening this burden on the plants. In my experience, if the indoor garden temperature is 75° the grower will almost certainly have hard going with all but desert plants. At 70° things will go much better. A night-time low of 65° will generally produce good results.

Overwatering will not solve the humidity problem. Water that does not drain away drowns the plant by filling the soil spaces and preventing the circulation of oxygen-bearing air, which the roots must have for respiration. The object of watering is to keep the growing mixture damp, never letting it dry out and never letting the plant stand in water. Each plant has its own requirements. Epiphytic ferns growing on bark will dry out more quickly than terrestrial types in pots. Observation is the key to success. Look at each plant each day and remedy accumulated water or dryness as soon as the condition becomes apparent.

I grow all my indoor ferns in containers with drainage holes. My growing media are comparatively inert, spongy and loose: osmunda fiber, sphagnum moss, a mixture of German peat and perlite, or a sand-peat combination. The important characteristics of all of them are the capacity to retain moisture and a porous structure which will allow air to reach the roots. Excess water drains through such a medium quickly and freely and leaves open spaces for oxygen.

Ferns are not as prone to insect damage as many other plant groups, but mealybugs and scale insects can be troublesome. Malathion, the standby control for such insects, will damage some fern foliage, as will nicotine sulfate and the dispersal agent in house-plant bombs. The best remedy for these and all other insect pests is frequent trips to the kitchen sink, where they can be washed off with a forceful spray of tepid water. All insects lay eggs, as do red spiders and spider mites, and the water will wash the eggs down the drain. You can also remove mealybugs with the time-honored device of a Q-tip, or you can flush them out with an electric tooth pick. This is about the most effective mealybug eradicator I have.

Regular application of a complete, soluble fertilizer will do much to promote lush, green growth. However, fertilization will not counteract the effects of poor culture or lack of the necessary environmental conditions. If a plant is in active growth, if it receives good light every day, if the humidity is suitable and the temperature appropriate for the species involved, fertilizer can often make the difference between vibrant green and pale color, and between vigorous and sluggish growth. I use a high nitrogen solution about once a month starting in late January (when indoor plants resume growth after their winter dormancy) and continuing through September. I never fertilize during October, November and December, because the short days in the northeastern part of the country during those months preclude any appreciable photosynthetic activity.

Suggested Ferns

Following are the ferns which I have found to be particularly satisfactory for growing in the house. I suggest them for the average window-sill gardener. Those with conservatory conditions can go farther afield, and those with a greenhouse can try the full range of 2000 kinds—if they can find them in cultivation today.

Maidenhairs, of which there are hun-

Edmund B. Gilchrist, Jr.

Lygodium japonicum, left, and *Nephrolepis* 'Norwoodi' in a north window.

dreds native to all the tropics and subtropics, have a special charm by reason of the delicacy of their fronds. Their Latin name means "unwetted," referring to the fact that water flows off the fronds without appearing to wet them. Their culture consists mainly of keeping the plants as cool as possible and protecting them from slugs.

The croziers emerge from the clumpy root and soon develop into the fronds which last from six to nine months before turning yellow. If they are allowed to grow naturally, the plants will always have a portion of their fronds in every stage of development, including the yellow stage. To achieve uniform, fresh, new growth, cut away all the fronds in late winter or 3 to 4 months before the time when the best effect is wanted.

Many species and varieties are available. Some of my favorites are *Adiantum cuneatum* (the species and many varieties); *A. caudatum,* a curious plant with tip-rooting fronds, and *A.* 'Ocean Spray'.

An evergreen, epiphytic fern native to India, China and Formosa, which I highly recommend, is *Aglaomorpha coronans.* Its thick, dark green fronds unfold from a soft brown rhizome, and under favorable conditions will grow up to 2 feet long and half as wide. (In the plant's native habitat the fronds attain a length of 6 feet.)

A plant I have had for three years already fills an 8-inch azalea pot. Because the fern is epiphytic, the growing medium is very light—a mixture of peat moss and perlite. I have seen others growing well in wire baskets and on slabs of cork bark. Two other species, *A. heraclea* and *A. meyeniana* are similar in appearance, and their culture is the same.

The bird's-nest fern, *Asplenium nidus,* has distinctive chartreuse fronds with a sharp black rachis, which make this fern unique. The fronds are large, up to 3 feet in length and 6 inches in width, and are boldly presented from a tufted root. The common name is derived from their basket shape and epiphytic habit which make them resemble a huge birds nest in the trees of the South Sea Islands.

Slugs quickly chew holes in the unfolding fronds. Metaldehyde in liquid form, poured or sprayed on the soil surface, will eventually kill the offenders. If a few drops fall on the fronds, it will not hurt them, but it will leave a powdery residue.

The feathery bright green fronds of the mother fern, *Asplenium bulbiferum,* are a striking contrast to the shining leathery fronds of the bird's-nest. The common name derives from the small fernlets which appear along the top edges of mature fronds. The holly fern, *Cyrtomium falcatum,* is a sturdy, terrestrial fern with dark green, leathery fronds. The variety 'Rochefordianum' is recommended because it is shinier and neater than the species.

The *Davallia* genus contains some 40 species, all tropical, epiphytic and characterized by feathery light green fronds and creeping, furry rhizomes. They are best grown in wire baskets or on pieces of driftwood with their fronds pinned down to a pillow of sphagnum moss or osmunda fiber. The most readily available are *D. mariesii (bullata),* the one frequently seen planted on fiber monkeys; *D. trichomaniodes* (often misnamed *canariensis*); *D. fejeensis,* the Fiji davallia, a deciduous species; *D. solida (lucida),* hare's foot davallia; *D. griffithiana,* rabbit's foot fern, distinctive because of its white rhizomes; and *D. pentaphylla,* a dwarf species with black, fuzzy rhizomes.

Southeast Asia is the home of an intriguing climbing fern *Lygodium* (*scandens*) *japonicum* with twining fronds, which are often several yards long. In spite of its delicate, feathery structure, the plant is surprisingly house-hardy. As in the case of the maidenhairs, I cut all fronds down to the roots once a year.

Fluffy varieties of the old-fashioned Boston fern, *Nephrolepis exaltata* cultivars, make attractive specimens when groomed and cared for. I grow them in pots and baskets, in sun or shade, and keep them for years. The constant removal of old browning fronds is something of a chore, but is essential if the plants are to be attractive. Some attractive varieties, readily obtainable, are 'Norwood', 'Verona', 'Whitemanni', 'Fluffy Ruffles', and 'Smith'.

The cliff-brake fern, *Pellaea viridis,* is a small bright green fern with shiny black rachis which resembles an oversize maidenhair. The fronds have numerous pinnae about the size of a half dollar when grown indoors.

Phlebodium aureum—(*Polypodium aureum*). Large, deeply cut, blue-green fronds and thick brown hairy rhizomes give this large fern a dramatic appearance and their leathery character gives it durability. The variety 'Mandaianum' is crested and more desirable.

The common name of staghorn fern, *Platycerium bifurcatum,* an exotic epiphyte, derives from the shape of the pendant, spore-bearing fronds, which on my own house-grown plants achieve a length of 2 feet. Another species, *P. grande,* requires somewhat more care and produces a handsomer specimen. Both grow better in cool temperatures and high humidity.

Stenochlaena palustris is a vigorous, large epiphytic fern which is classed as a climber. The scaly rhizomes are long and bear hold-fast roots. In the swampy jungles of Southeast Asia, it climbs up the tall trees seeking the light it needs to produce enormous, drooping fronds with bright green leathery pinnae. ◆

Edmund B. Gilchrist, Jr.

Nephrolepis 'Verona', a cultivar of the Boston fern, will grow in the shade; or, like this specimen in a sphagnum-lined basket, it will thrive in a partially sunny window.

FERNS FOR SOUTHERN GARDENS

Mary Noble

FERNS ARE VALUED and useful plants in Southern gardens. They present a cool, green look even on the hottest summer day; and once properly established, they require little maintenance.

Florida could be called "the land of ferns" as well as "the land of flowers," because 107 species are native here. This is said to be more native species than any other state possesses, but it is still a minute percentage of the world's fern population. (Of course, many Florida fern species extend their range to the north and south, and are not exclusive to this region.)

Almost all of the ferns do best in shade or dappled sunlight. They like woodsy soil, either naturally so or made so with compost, peat moss or leaf mold. The soil needs to be moisture-retentive, but only the swamp ferns can endure standing water.

Ferns need protection from strong winds. This may be provided by buildings or by larger plants to the windward side of the planting. Garden use of the various ferns is limited, even in the South, by the cold hardiness of the species. The tenderest sorts should be grown in containers so they can be moved to shelter in cold snaps.

In the South we grow ferns as ground covers in the shade of our large evergreen trees; along creek or river banks; beside fish pools (but not swimming pools); in shady corners of the garden. They do well in our parkways between sidewalk and street, where maintenance is often at a minimum, providing soil and light are suitable.

For spectacular decoration, we use masses of ferns along curving driveways. And we hang big baskets of graceful ferns on our porches and in our patios. Big balls of tree-fern fiber a foot or more in diameter make excellent hanging "containers" for ferns, which are attached to the fiber with hairpins.

The old familiar Boston fern (*Nephrolepis exaltata bostoniensis*) is a Floridian, and it will grow almost anywhere

Mary Noble

Brake fern in basket is readily moved when frost or strong wind threatens.

The form of Boston fern, a Florida native, shows to advantage in a basket.

here. It clings to the bricks of walls and walks, spreads under azaleas, clings to palm-tree trunks. But it can be trained into scroll patterns for massed ground cover beneath shrubs and trees. It is attractive in portable hanging baskets for semi-shady places. Watering only once a week is necessary when the Boston fern is well established.

Growing the leatherleaf fern commercially is quite an industry in Florida, but this is also a handsome garden fern for planting beneath *Magnolia grandiflora* and other large trees.

The various maidenhair ferns are very attractive and graceful. Given proper light, soil and moisture, they can be massed in front of shrubbery borders or camellia beds, or used in porch boxes or other large containers. They grow without attention beneath the greenhouse benches, taking with thanks whatever water and fertilizer falls from above.

Holly ferns have long, dark-green, glossy fronds and grow in graceful clumps two feet high. They are splendid foreground plants in the garden when used to separate the shrubs and the lawn, and are excellent as edging along walks. The holly ferns require lots of water and thrive on a very weak application of liquid food every other week in summer.

The sensational tree ferns of the tropics will grow well up into the base of the Florida peninsula in protected locations, but here in Jacksonville they are not dependably hardy over a long period of time. In South Florida and the islands they are huge and graceful.

Staghorn ferns (*Platycerium*) are favorites for hanging use. They can endure temperatures down to freezing, but not below. Handsome specimens can be grown on flat fiber slabs, or they can be mounted around wire baskets.

The brake ferns (*Pteris*) have extremely variable foliage, and a number of cultivars are available. These are tender to frost and to excessive sun and wind, so it is best to grow them in containers in protected locations. Large specimens are handsome in hanging baskets.

The best way to plant any garden fern is to prepare the soil with humus (peat moss) and dig out a bowl-like depression. Then spread the roots wide rather than jamming them down in a deep but narrow hole. In covering, keep the crown above the soil but cover all the roots. A mulch of old leaves, kept free of the crown, helps to maintain moisture. Staking a newly set fern for security is preferable to packing down the planting medium, as the roots need aeration. ◆

Rabbit's-foot fern ball. Grown, like others shown, by Mrs. E. Reed Brelsford.

Leatherleaf fern thrives as an outdoor planting under large trees in the South.

FERNS OF THE PACIFIC NORTHWEST

T. M. C. Taylor

THE PACIFIC NORTHWEST, the region that includes Oregon, Washington and British Columbia, has a climate that ranges in winter from general mildness, with a few degrees of frost, along the coast, to severe conditions, with temperatures many degrees below zero, in the interior. There is as little rainfall as 10 inches a year in eastern Oregon, eastern Washington and southeastern British Columbia, while west of the coastal mountains twenty times as much may fall. Gardeners in the Pacific Northwest consequently must select their plants according to where they live, whether in the wet, mild coastal region or the dry interior, with its hot summers and cold winters.

Ferns are usually regarded as being plants of damp shady places, primarily woodlands, but there are of course a number of exceptions. For example, the cliff brakes (*Pellaea*), certain lip ferns (*Cheilanthes*) and woodsias are restricted to dry, rocky sites. Damp, woodsy places are characterized by slightly acid soils rich in humus and organic matter; but again, certain fern species are adapted to calcareous or serpentine areas with basic (alkaline) soils.

On a geographic basis the ferns of the Pacific Northwest fall into two main groups: those that are wide-ranging, occurring as far away as eastern North America, and those that are limited, in North America, to the Pacific Coast region. The ferns with garden merit that are native to the Pacific Northwest are discussed below.

Blechnum spicant—Hard Fern, Deer Fern. Limited to the Pacific Coast in North America, it is also found in western Europe. It thrives in humid places in rather deep shade. It has two kinds of fronds: the vegetative fronds, evergreen and somewhat hard, form flat rosettes against the ground from the center of which the tall, narrow fertile fronds arise. The fertile fronds are annual, withering in late summer. The deer fern is a welcome addition to a wooded garden in regions where winter conditions are not too extreme.

Cheilanthes feéi—Slender Lip Fern. This member of a large group of Southern rock ferns is found in the Pacific Northwest on dry limestone cliffs. In the garden it will tolerate more moisture than in the wild, but it must have good drainage and does best with some lime in the soil. It is excellent for the rock garden. In nature it endures 10 to 15 degrees below zero.

Cheilanthes gracillima—Lace Fern. This species is most commonly found in association with igneous and acid rocks. It is a small tufted species with almost bead-like frond segments. It will tolerate some shade and more moisture than the slender lip fern.

Cheilanthes siliquosa (Also listed as *Onychium densum* and *Pellaea densa*)—Indian's Dream. The significance of the common name is not clear, but there is no doubt as to the attractiveness of this little blue-green fern with fronds divided into linear segments. It is usually a plant of shallow soil over rock, or of rocky soil with good drainage. It thrives in serpentine and slightly alkaline soils moistened by seepage. This is another gobd plant for the rock garden, where it will tolerate full sun if the summers are not too hot and dry.

Cryptogramma crispa acrostichoides—Parsley Fern. A low, tufted fern of talus slopes and other well-drained rocky slopes in full sun. It carries its narrow, fertile fronds erect and well above the less dissected, low-spreading vegetative fronds. It readily adapts itself to the rock garden.

(Continued on page 23)

All photographs by Don Normark

Lace fern *(Cheilanthes tomentosa)* thrives in scree, with roots shaded by stone.

Ferns in Pacific Northwest Gardens

Landscape architect George Schenk uses ferns generously as shown in the accompanying photographs. "In nature, ferns make swamps and cold stone appear friendly," he writes. "In gardens they are so cooperative that some varieties—those with bold, firm fronds — balance strength and grace within themselves and so create an entire landscape composition."

Left: *Pellaea brachyptera,* a native fern of the region.

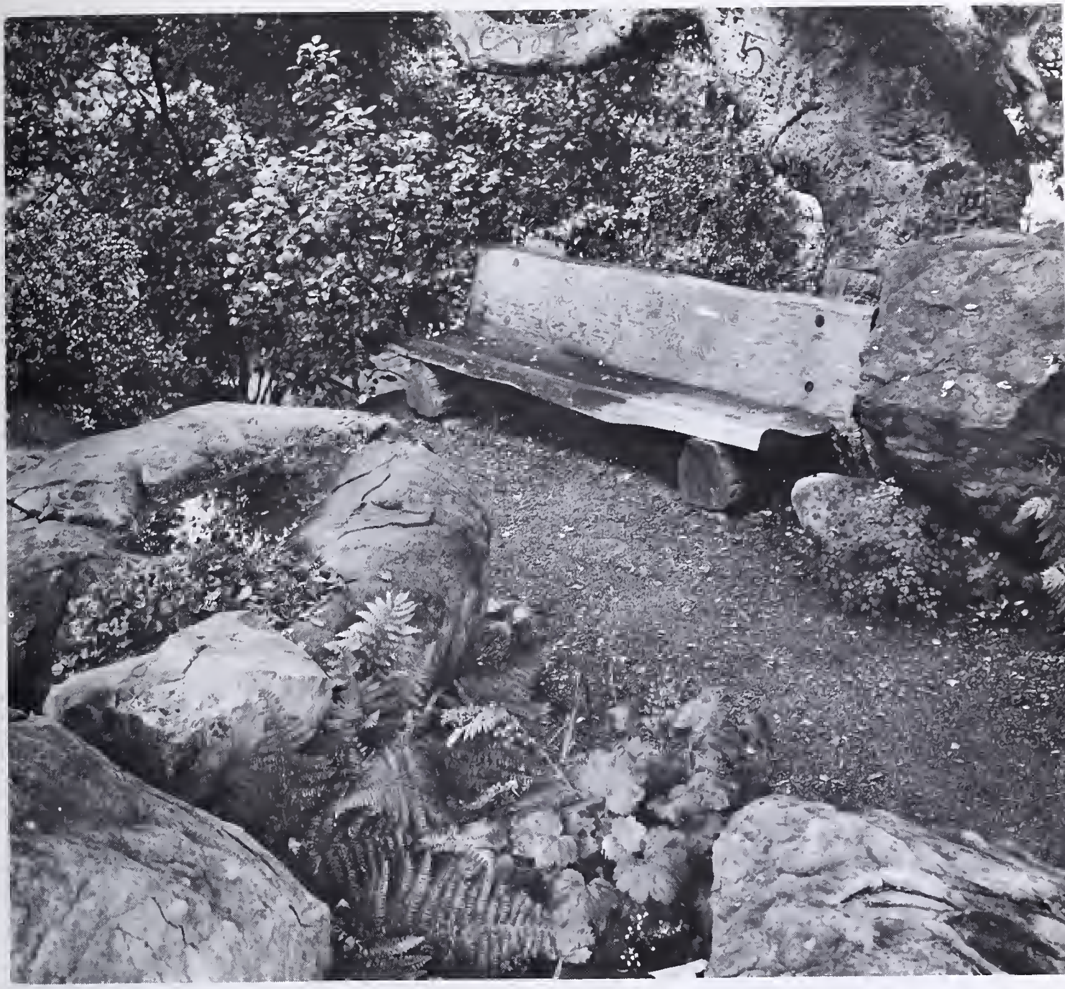
(*Continued*)

Sword ferns in a Seattle garden room. In container, at left, is an equisetum.

Triangular composition of sedums, ferns, and agave; the ground cover is ajuga.

Lane Magazine and Book Co.

Plants of southern sword fern grow among boulders in a contemporary dooryard.



Grace and detail are added to a rugged spot in the Santa Barbara Botanic Garden by a tiny reflecting pool and the placement of plants, including the fern *Dropteris arguta* (formerly *Aspidium rigidum*) close to rocks. The rustic bench has been hewn out of redwood and the little water basin hollowed out of natural sandstone. It is fed, drop by drop, by a hidden hose. Concerning the planting of fern divisions between and among rocks (see also photograph on page 19), Mr. Schenk writes: "For me, the trowel is too coarse for such work and I have trained my left hand to administer to the soil a kind of gardener's karate."

(*Continued*)

Cheilanthes siliquosa, with needle-like leaves, is suitable for rock gardens.

A green garden mimics the forest floor in a shady, moist area. Ferns contribute strongly to the contrast of patterns and textures essential for interest in such plantings. Plants include, from top to bottom, *Petasites speciosa, Polypodium vulgare occidentale, Dryopteris arguta* and *Asarum caudatum.* Mr. Schenk describes this planting, which is in the Santa Barbara Botanic Gardens, as a "self-sufficient community of woodland ground covers."

(*Continued from page* 18)

Dryopteris arguta—Coastal Shield Fern. A rare fern in the Pacific Northwest that can sometimes be obtained from nurseries and is very well worth growing for its firm dark foliage. When established in a well-drained shady situation it will form good-sized clumps through the development of underground stems.

Dryopteris filix-mas—Male Fern. This tall, circumpolar species is sufficiently rare in eastern North America that it is not likely to find its way into many gardens. In southern British Columbia it is not uncommon in damp rocky woods under evergreens. Its cultivation presents few problems if it is given a good woodsy soil and reasonable moisture. Moderate shade is desirable.

Polypodium vulgare glycyrrhiza—Licorice Fern. Another Pacific Coast species that despite its commonness should always be included in a shady garden. In nature, while it is often found growing on the mossy trunks of the broad-leaved maple, it is also common on mossy rocks, where it forms large mats. It is similar to the common polypody of the East but is winter-green, the fronds dying down in the summer. The sweetish licorice taste of the spreading rhizome is distinctive.

Polypodium scouleri — Leathery Polypody. This member of a great group of tropical and subtropical species is strictly maritime in its distribution. It has coarsely divided fronds with firm segments rounded at their tips. Its habit of growing epiphytically suggests it as a good subject for hanging baskets, but special care must be taken to prevent it from drying out.

Polystichum andersonii—Anderson's Holly Fern. Unfortunately this large Western relative of Braun's holly fern is quite local with us. It occurs in shady woods to the west of the coastal mountains. When growing conditions are prime, the fronds will be more than three feet long, erect in a vase-shaped arrangement. An unusual feature of this species is the development of a bud near the tip of most fronds. In autumn the ends of these fronds can be layered; plantlets will appear from the buds in the following spring. When placed in the garden, special care should be taken to minimize wind damage to the handsome fronds.

Polystichum munitum—Western Sword Fern, Giant Holly-Fern—The lush growth of this large and attractive fern gives a tropical appearance to some of our most luxuriant woods. It is similar to the sword fern of the East but is much larger, with glossy fronds three feet or more in length. It is highly recommended for places in the garden where its size will be in scale. It also scores extra points for having evergreen fronds.

Woodsia scopulina—Mountain Woodsia. On talus slopes and in rock crevices in the dry interior, this is the commonest fern. Its slender, somewhat greyish fronds grow in tufts and are easily confused with the fragile or brittle fern (*Cystopteris fragilis*). This species of woodsia can easily be recognized—a magnifying glass will show whitish hairs on the back of the fronds that are lacking in the fragile fern. This woodsia is easily transplanted and grows satisfactorily in well-drained pockets in the rock garden. In very dry weather its fronds may die down, but new ones will appear with the return of damp conditions. A similar species is *Woodsia oregana* (Oregon woodsia), which lacks the whitish hairs. The two are often found growing together.

Woodwardia fimbriata—Giant Chain Fern. This is the largest and handsomest of all ferns native to our region. In well-grown specimens the fronds may reach six feet in length and a quarter as much in width. Unlike its Eastern relations, it has a short, thick stem from the end of which the fronds arise in a circle. The sori are large and conspicuous in two rows on each frond segment. The chain fern is found only to the west of the coastal mountains. It is characteristically a fern of the redwood forest, and its range barely reaches southern British Columbia. For best growth it requires plenty of summer moisture.

Other desirable ferns for this area are also native to the Northeast. ◆

Photographs by F. Gordon Foster

Mount McKinley, 20,320 ft., above one of North America's most beautiful parks.

AN ALASKAN FERN-HUNTING TRIP

F. Gordon Foster

ALASKA, our forty-ninth and largest state and last frontier, is rich in unusual flora and fauna. In this new state, a former territory once considered only a vast, inaccessible wilderness, man has thus far had little time or opportunity to change its natural life or beauty.

About one-fourth of Alaska's 586,400-square-mile area lies above the Arctic Circle. The Alaska Peninsula, extending southwestward, divides the Bering Sea from the Pacific Ocean. The Panhandle is a narrow strip of mainland and many islands that extends south along the Canadian border. The terrain ranges from valleys with rich soil suitable for agriculture to lofty snow-capped mountains unexcelled for scenic beauty. The climate of the lower coastal areas, greatly influenced by Pacific Ocean currents, is generally mild, with rainy winters. The extreme northern part of the state has such a severe climate that habitation is sparse.

Rather than taking a standard tour in which many features are hastily covered, my wife and I decided to visit only areas of special interest and make longer stays. To this end a 24-day trip was roughly divided between Glacier Bay National Monument, Mount McKinley National Park, and Katmai National Monument, with its Valley of Ten Thousand Smokes. Short stops en route at Sitka, Juneau and Anchorage were included.

Sitka, the old Russian settlement and the first Alaskan territorial capital, was our first stop. This little coastal town on Baranof Island, with about 3,200 inhabitants, depends largely on fishing and pulpwood cutting. Because of its southerly location and abundant rainfall, the vegetation is lush and fast growing.

Fern hunting in Sitka was preceded by

a boat trip to the bird refuge on the volcanic island of St. Lazaria. Although the weather was cold and overcast, hundreds of birds of many species, including the guillemot, oyster-catcher, murre, tufted puffin and bald eagle, were seen.

Our boat-trip host and hostess were equally acquainted with the land. Using their double-drive jeep, it was possible to explore both highway and logging trails in the nearby mountains. Sitka spruce grew in abundance. Rich areas of ground plants thrived along the roadside and on cut-over land where the light level was higher than in the forest. Among the ferns there were the common lady fern, *Athyrium filix-femina,* smaller patches of *Thelypteris phegopteris* (or *Phegopteris connectilis*), and the little oak fern, *Gymnocarpium dryopteris,* which is so uncommon in our northeastern states. Deer fern or hard fern, *Blechnum spicant,* not native in the East, was found frequently along the roadside and in logged-over areas.

At the outskirts of the town we found an old Russian cemetery. Spruce trees and large cow-parsnips had turned hallowed ground into a virtual jungle. In addition to the beech fern and oak fern already seen, a new fern was added to our list, the Sitka lady fern, *Athyrium filix-femina* var. *sitchense.* This fern is the giant of the lady ferns, its leaves having a height of 6 feet.

Our next stop was at Glacier Bay National Monument. The monument is reached by plane to Gustavus and overland by bus to the lodge. To fully appreciate the flora of Glacier Bay it is necessary to hark back to 1794. When Captian George Vancouver first sailed into this area he found an immense wall of ice blocking what is now Glacier Bay. The ice extended to the north for over a hundred miles, covering the basin to a width of 20 miles or more with a mantle of ice in places more than 4,000 feet deep. Ring counts on the Sitka spruce dominant in the area today indicate an age of about 125 years. From this it seems that a period of about 75 years from the retreat of the ice was required for the ground-cover growth to become sufficient to sustain higher plant life. Although the monument area is heavily covered with trees, some flat, open land may be seen along the road to Gustavus.

It is difficult to describe one's feelings in this far north country. The forest is unusually quiet, many of the woodland sounds being dampened by the heavy fern-like moss which covers the ground, the massive boulders and the fallen trees. Trails through the forest are well defined in a few areas; other places are only occasionally marked with a red tape on widely spaced trees. It is not advisable to go far from the trails, as there is always the possibility of getting lost or meeting a stray bear.

Fern growth in the dense forest was sparse; in general, it was restricted to the forest edges or less dense stands of trees. Between the lodge and the tidal inlet both the spreading shield fern, *Dryopteris dilatata,* and the oak fern were abundant. Both of these species had strong, well-developed leaves and were growing among lightly moss-covered rocks or directly on a humus of decaying needles and cones from the adjacent forest.

A woodland trail starts from the lodge and parallels the tidal inlet for about a mile. Just off the path I found the mountain holly fern, *Polystichum lonchitis*; at this station there were two plants about 12 feet apart. Both plants were in excellent condition, with last year's prostrate leaves yet to turn fully brown and the foliage of the current year represented by verdant, mature fertile leaves and unfolding central croziers. Some distance beyond and off the trail a station of three closely spaced Braun's holly ferns, *Polystichum braunii,* was discovered. These plants were growing on a deep covering of moss which prevented the rhizome-root system from reaching the soil. The individual leaves were comparable to those found in the New England mountains, but there were only a few leaves on each plant.

Growing in the moss were many small flowers; especially numerous was a small

(*Continued*)

woodland orchid similar to our twayblade. On three boulders the rock-cap fern, *Polypodium virginianum,* was found growing as a single-leaved depauperate (imperfectly developed) plant. At each station the moss was so thick that it was not possible for the fern to get a foothold on the surface of the rock.

Gustavus, nine miles from the lodge by gravel road, is a small town of less than 250 inhabitants, its main reason for existence being a small airstrip where planes land passengers and supplies for the area. Along the edges of the road through the forest, where light was more abundant, lupines, columbine, pyrola, orchids and insectivorous plants were growing in profusion.

Between the Gustavus road and a parallel drainage ditch there was a moss-covered strip continuing for several hundred feet. In this strip two species of grape fern were found—rattlesnake fern, *Botrychium virginianum,* and the rare moonwort, *B. lunaria.* The rattlesnake fern was represented by only one robust, fertile plant with its blade well above the moss. Although this fern was growing in full sunlight, it was similar to plants generally found in wooded areas and thickets in the eastern states. The moonwort is a very small plant and in the eastern states is seldom found below the Canadian border. Along the Gustavus road there were many plants, all with their blades slightly above the damp moss. A great variation in the cutting of the pinnae of these plants was observed—some pinnae were entire, some slightly notched, and others deeply incised.

Mount McKinley National Park is about an eight-hour trip from Anchorage. Our train, composed of four passenger cars, diner, and more than 30 freight cars, traveled at a slow pace upgrade and through winding mountain passes. Frequent stops were made to allow passengers to see and photograph the countryside. Fair weather, with deep blue skies and many white, billowy clouds, permitted excellent visibility of Mt. McKinley throughout the journey.

From the train, in the area south of Curry, massive stands of ostrich fern, *Matteuccia pensylvanica,* could be seen. These stands grew along the railroad drainage ditch and continued up the damp slopes for 200 feet or more. Occasional thick stands of oak fern and spreading shield fern were also seen.

The hotel at Mount McKinley Park is set in a coniferous forest at an altitude 1,732 feet above sea level. A short-cropped lawn composed of miscellaneous grasses, weeds and scrubby flowering plants extends from the hotel porte-cochere to the roadway. Just beyond where the lawn meets the woods there were many specimens of the moonwort. In contrast to those growing at Glacier Bay in moist moss, these plants were growing on a dry gravel surface. Our photographing such tiny and long-unobserved forms of plant life caused much curiosity among other guests and rangers.

About a half-mile uphill from the hotel we found a small unprotected gravel-covered knoll. Several species of flowers could be seen from a distance but, best of all, a closer look revealed many plants of the fragrant fern, *Dryopteris fragrans.* This fern, rare in the East and really not common in Alaska, is one of the smallest of the *Dryopteris* genus. It is an evergreen species and grows from a crown, the leaves of the current year arising amid the mat of dead, curly brown leaves of last year. The leaves are about 10 inches long and are characterized by stubby pinnae having blunt segments with incurled margins. The real beauty of this fern can only be appreciated by using a magnifier to reveal the shaggy brown scales on the petiole and rachis and the kidney-shaped, glandular-edged indusia.

Descending the trail from the hotel to Horseshoe Lake, we found the fragile bladder fern, *Cystopteris fragilis,* growing beneath overhanging turf. Here there were only two plants within a distance of 10 feet. Neither plant was as robust as those we have found in the East growing from clumpy mats.

Katmai National Monument, reached by way of Anchorage, was our last major stop. This monument, which includes Katmai Volcano and the Valley of Ten Thousand Smokes, is on the Alaska Peninsula and can be reached only by small seaplanes or amphibians from the supply base at King Salmon. In addition to the Valley, with its volcanic phenomena, other attractions in this relatively new, 4200-square-mile reservation are the sight of the big salmon swimming upstream and leaping over waterfalls to the Brooks Lake spawning grounds, big moose, and the large brown bears.

The valley is reached by a high-wheel bus capable of fording four swift-flowing streams which are sufficiently shallow to allow summer passage. To actually reach the valley floor it is necessary to walk about two miles, descending 900 feet on a hot, dusty trail. In studying the flora here one must remember that the area is relatively young, since the 1912 eruption of the volcano buried the vegetation of a wide region under ash and pumice. It is reported that more than 40 square miles of the valley floor were covered to a depth as great as 700 feet.

No ferns were found on the valley floor. Beneath the overhanging turf of the roadcut to the valley we saw a few stands of depauperate oak fern. Farther along, a large stand of alpine lady fern, *Athyrium alpestre,* was found growing in a wet pocket on a grassy slope. This fern intrigues me. My first experience with the species was on a rocky mountain pass, at a 4,000-foot elevation, between Oslo and Bergen, Norway. Identification was at first confusing; its naked sori were like those of the genus *Polypodium*; its leaves, with straw-brown scales, formed a vase-like pattern like that of our genus *Dryopteris,* and the blades were soft to the touch, in common with our genus *Athyrium*. Further study of the plant has shown that in the past it has been assigned to many other genera.

Mt. Dumpling, 2,400 feet high, is reached by hiking two miles from the Katmai–Brooks River lodge. While this

Horseshoe Lake in McKinley Park, visited by author in search for Alaskan ferns.

mountain knoll still has a layer of volcanic ash, there is sufficient soil to support a lush vegetation on the lower slope. In the damper areas the spreading shield fern, the oak fern and the narrow beech fern were abundant. Toward the summit these ferns disappeared and vegetation changed to scrubby bushes until the more arid, exposed volcanic summit was reached. Mt. Dumpling and the other knoll-like prominences were virtually covered with a mass of alpine flowers—harebells, mountain rhododendron, saxifrages and buttercups—truly a reward for a long climb.

Each park area we visited seemed to have its own ferns as a reward for the visitor. At Mt. Dumpling the prize was the little rusty woodsia, *Woodsia ilvensis*. This little fern seems to shun good soil and seeks a sunny, windy, cold winter exposure. At this station it was growing in a setting of alpine flowers—a sight long to be remembered.

Anchorage is a modern city that has emerged from the destructive earthquake of 1964. The city is not only a focal point of the state, but a city of international importance, a gateway to the United States and Canada and a springboard to the Far East. Here garden-minded homeowners use the ostrich fern and the western dagger fern, *Polystichum munitum*, as background plants in gardens. ◆

Bay of Islands, Katmai region, shows effects of relatively recent volcanic activity.

FERNS OF THE PINE BARRENS

Dorothy Stewart Evert

THE EASTERN SEABOARD from Boston to Washington is justly called a megalopolis. City crowds upon city—the suburban sprawl bulges from the perimeter of one city to meet that of the next.

How amazing, then, to find in the heart of this huge metropolitan area a space of near-wilderness! Known as the Pine Barrens of New Jersey, this wilderness is an area of 3,000 square miles, in the coastal plain of southern New Jersey. Since early in the nineteenth century it has been a mecca for botanists, for many curious and unusual plants grow in its acid soils.

The dry forests of pine and oak are laced with slow-moving, tea-colored streams whose edges are lined in many places with open, sunny bogs and cool cedar swamps. The streams are the surface aspect of an immense, incredibly pure aquifer (water-containing geological formation), perhaps the greatest in this hemisphere.

Scattered throughout the Pine Barrens are the sites of many once-thriving towns which grew up around the iron furnaces, glass factories and paper mills that prospered in the region in the early nineteenth century. One fern is an almost sure indicator of past habitation: whenever the ebony spleenwort, *Asplenium platyneuron,* is found, near by are the remains of foundations whose mortar has provided the lime which, by partially neutralizing the intensely acid soil, has enabled the species to exist in the Barrens.

While more than 20 species of ferns are known to exist in the Barrens, relatively large numbers are found growing in areas that at one time or another have been disturbed or inhabited by man. At the site of the colonial iron town of Martha an outstanding naturalist, Louis Hand, checked 13 species of ferns within a 100-foot radius. Of these, only 5 are widely distributed throughout the area.

Within the radius examined by Mr. Hand one very common Pine Barren fern was not found, although only a short distance away it grows in abundance. This, the common bracken fern, *Pteridium aquilinum,* is a frequent understory plant in the dry, open forest. It is one of the first plants to spring up after fire. In late summer it turns a lovely soft brown; and in some areas of the Barrens the level tops are in evidence as far as the eye can see.

Witmer Stone's account in *The Annual Report of the New Jersey Museum for 1910* is still the most complete flora of the Pine Barrens. However, it seems strange that it does not list the common hay-scented fern, *Dennstaedtia punctilobula,* for it is now found in many dry, sunny places; but, like the ebony spleenwort, it has evidently come in as a result of man's activities.

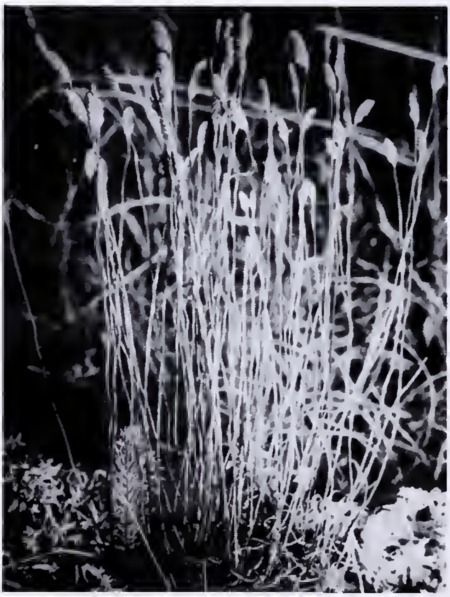
Stone lists only 15 fern species in the Pine Barrens. One on his list has not, to our knowledge, been seen in recent years. It is the oak fern (*Phegopteris dryopteris,* as it was named in his day; *Gymnocarpium dryopteris* today). This typical upland species was found in the shaft of an old well in the long-since-vanished town of Calico. Now cranberry bogs are established where this village once stood, and no trace of any well is to be found. Fern spores can travel great distances, however, and perhaps, some day, the oak fern will be found again in a suitable Barrens habitat. In part, it is the pleasurable surprises of rediscovery that keep the naturalist searching!

Although the word "Barrens" suggests a fruitless, infertile land, without capacity to attract or interest the visitor, nothing could be further from the truth. The Pine Barrens region was so called because it was found to be unproductive for ordinary farming in the early days. Now, however, plantations of blueberries (*Vaccinium* sp.) and large bogs growing cranberries (*Vaccinium macrocarpon*) flourish there in the acid soil. The vast quantities of available water nourish these plantings, especially the cranberry bogs, many of which are established on cut-over cedar swamps.

The wet places of the Barrens are where ferns abound. The net-veined chain fern, *Woodwardia areolata* (or *Lorinseria areolata*) and Virginia chain fern, *Woodwardia virginica,* line the dikes and flourish in the ditches along the Pine Barren roads. The latter fern shows a charming red pigmentation in spring—a characteristic feature of this plant. In August it begins to turn bronze. In many damp places the lovely marsh fern, *Thelypteris palustris* (*Dryopteris thelypteris* of some authors) shows its thinnish, blue-green fronds.

Early spring finds the fiddleheads of the cinnamon fern, *Osmunda cinnamomea,* emerging. These fuzzy, cinnamon-colored coils are the fertile fronds and unfold in a fascinating pattern. By midsummer the fertile fronds have withered but the sterile fronds make gracefully arched clumps in damp places.

At the edge of the vast cedar swamps in June the royal fern, *Osmunda regalis,* shows its fertility. These lovely, elegant plants bear an apt common name, for they are truly regal. Several pinnae at the tip of the frond are replaced by clusters of sporangia. These soon wither but the plant keeps its beauty well into fall, frequently turning a reddish-bronze color.


The Pine Barrens' own fern, *Schizaea.*

The fern of the Barrens with true star billing is the curly-grass fern, *Schizaea pusilla.* A curious, unfernlike plant, it holds the universal interest of botanists. Many times we have had the pleasure of guiding a visitor from far shores to its hiding place. It is most often found at the base of the Atlantic white cedar, *Chamaecyparis thyoides.*

The curly-grass fern is so small that it is difficult to find until you become well aquainted with it. Then you realize it is really rather common in the Pine Barren region. The stipe of the fertile frond looks like a thin piece of green wire that has been stretched as straight as possible after being twisted. At the end of this stalk is a one-sided, divided blade holding the sporangia. The entire fertile frond scarcely reaches the height of 4 inches. If the fertile frond resembles an uncoiled wire, the sterile fronds suggest coiled pieces. They, too, are wiry and look much like the springs of a watch. Its common name, curly-grass fern, is indeed appropriate.

One interesting aspect of its habitat is that it is almost always shared with the Carolina clubmoss, *Lycopodium carolinianum.* Curiously enough, although the genus *Schizaea* is chiefly tropical, *S. pusilla* is found in North America only in the Pine Barrens and the cold northern region of Nova Scotia and Newfoundland. Why then does it have such a close affinity in New Jersey with the southerly Carolina clubmoss? One can merely observe that the Pine Barrens is a place where many northern plants reach their southerly limit—an example is the broom-crowberry, *Corema conradii*—and southern plants have their northerly limit. An example of the latter class is the Southern fringeless orchid, *Habenaria integra.* ◆

All photographs by Roche

Mid-June in the Great Swamp finds the common bracken *(Pteridium aquilinum)* at the height of its beauty. More than 600 plant varieties have been recorded there.

Ferns to see in

NEW JERSEY'S GREAT SWAMP

SAVED from becoming a jetport by hundreds of conservation-minded organizations and individuals, more than 4,000 acres of the Great Swamp of northern New Jersey are now included in a National Wildlife Refuge.

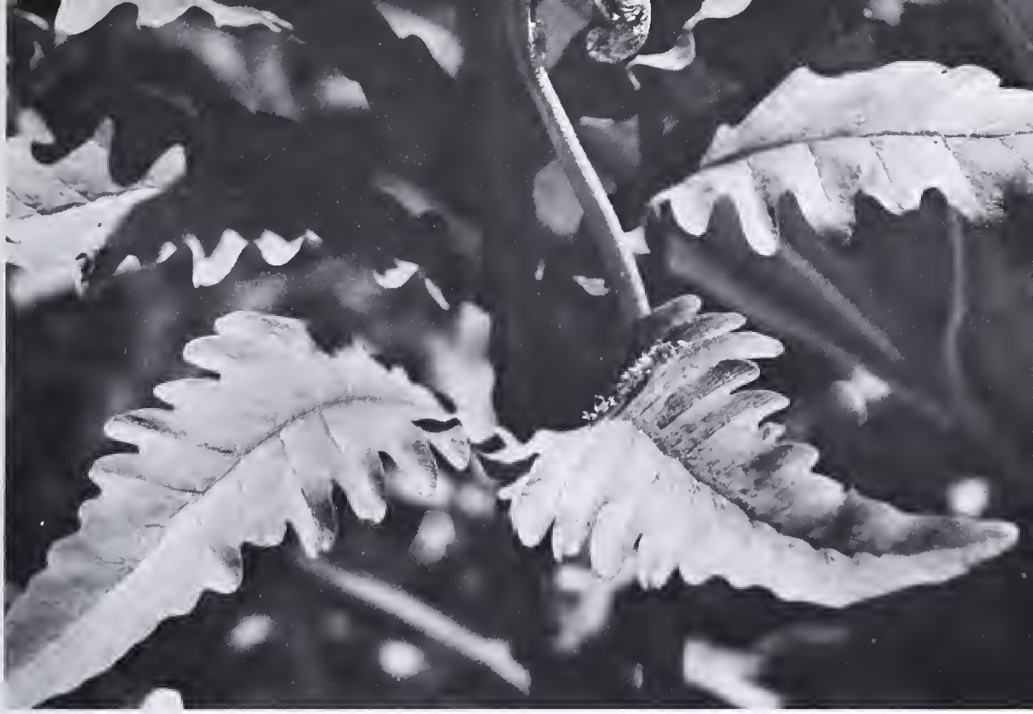
Rich in plant and animal life, including many ferns, the swamps, woodlands, meadows and marshes of the Great Swamp have long been the delight of nature lovers. The area was saved from "progress" in a fight led by the North Jersey Conservation Foundation, formerly the Great Swamp Committee of the North American Wildlife Foundation.

A Morris County park adjacent to the Refuge includes a nature-education center and a self-guiding nature trail.

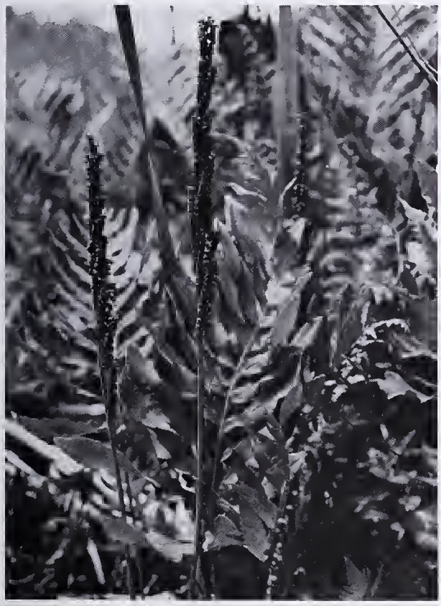
(*Continued*)

In May, cinnamon fern croziers thrust through leaves and litter of last year's growth. The endless cycle of growth, death, decay and rebirth continues.

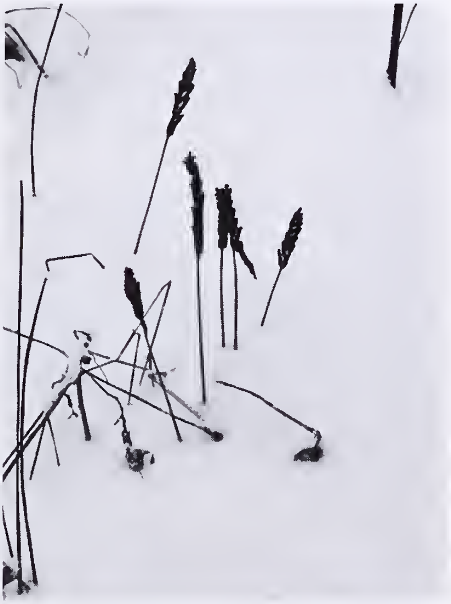
Below, mid-June finds cinnamon ferns in full leaf. Inconspicuous marker bears label for visitors' information.



Well into May the croziers of sensitive fern (Onoc*lea sensibilis*) are still appearing, although some will have unfurled as early as April in favored spots.



Spore cases of sensitive ferns in June. First frost will brown the leaves.



Erect in the snow, records of a season's growth: sensitive fern spore cases.

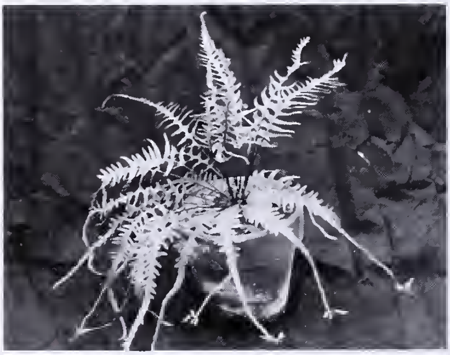
GROWING FERNS IN ROCKS

Edgar T. Wherry

IN POPULAR FERN BOOKS of the last century, references were occasionally made to growing some of our native rock ferns indoors, either on masses of porous limestone or on rock-like assemblages of pumice held together by Portland cement. When around 1915 I became interested in these plants. I considered the possibility of such cultivation in order to gain better acquaintance than was possible from merely observing them on visits to their native haunts. It proved impracticable, however, to pry out from their crevices tufts of plants like the Appalachian spleenworts and to get them growing again on loose rocks, since the numerous essential deep-penetrating roots left behind would fail to regenerate.

At the time, however, I was collaborating with Dr. Frederick V. Coville in his experiments on blueberry culture, and he suggested trying with acid-soil ferns a plan he had found successful with small ericaceous plants, namely the use of nested flower pots. The inner pot is filled with a mixture of silica and finely sifted acid peat, and the space between the two is stuffed with sphagnum moss to hold moisure.

This plan worked well, and I was soon familiar with the seasonal aspects of *Asplenium bradleyi, A. montanum* and *A. pinnatifidum* as well as of members of other rock-fern genera. Plants of these collected at moderate altitudes south of 35° North latitude seemed to find the mere change in day length from summer to winter sufficient to break the dormancy of rootstock-tip buds, and so continued to grow in the greenhouse. Those from higher altitudes or more northern latitudes required their containers to be placed for a month or two during winter in a room where the temperature fell to around 40°F.



Scott's spleenwort (*Asplenium ebenoides*)

On a trip to Havana, Alabama, I collected plants of the vigorous strain of walking (or Scott's) spleenwort (*Asplenium ebenoides*) growing there (subsequently found to be a tetraploid). This thrived especially well; and as shown in the illustration, its fronds tended to droop over the edge of the outer pot and to give evidence of the *Camptosorus* ancestry by tip-rooting. (Material from this collection was also given to the late Miss M. E. Groff of Lancaster, Pa., who grew it for years in a terrarium, where it produced numerous sporelings, which she shared with other fern enthusiasts.)

For species occurring in nature on calcareous rocks, the silica sand in the inner pot was mixed with an equal amount of fine limestone gravel, again with satisfying results. Not only could *Asplenium ruta-muraria* be grown, but tufts which in the wild had produced narrow *"ohionis"* or *subtenuifolium* pinnules tended to become normal, with broad ones. The two *Pellaea* plants of the genus, *P. atropurpurea* and *P. glabella,* remained wholly distinct in pot culture, so they are not, as has been suggested, mere varieties.

Recently there has come into horticultural use a sort of super-pumice known as feather rock, which promises to make practical a revival of the cultural plan I mentioned above. It can be readily cut into blocks of any desired shape and cavities can be drilled for the insertion of plant roots. ◆

Where to see ferns:

MAN-MADE COBBLES FOR LIME-LOVING FERNS AT TUPPER HILL

ONE OF THE AIMS at Tupper Hill (the Norcross Wildlife Sanctuary) is to provide the proper environment for all kinds of plants that are native to the Eastern Seaboard from the Carolinas to Canada. The Sanctuary, which is open to the public by appointment, comprises about 2000 acres of wooded hills, lakes and streams. It is located at Wales, Massachusetts, about 23 miles from Springfield and 35 miles from Hartford, Connecticut.

Tupper Hill is not in the limestone belt of Massachusetts, so most of the cobbles there have been man-made of limestone rocks and soil brought in from the western part of the state. Two of the most intriguing cobbles that have been built to accommodate lime-loving rock ferns are the Water Hole Cobble and the Cheilanthes Cobble.

Miss Ethel Stella, who is vice-president of the Norcross Wildlife Foundation, writes: "The Water Hole Cobble is constructed entirely of limestone. It is in three sections; a wall built into the cut bank, a mounded area and, in between, a gentle slope built to simulate the areas where Scott's spleenwort is found. Growing on this cobble are purple cliff brake, green spleenwort, American hart's-tongue, maidenhair spleenwort, ebony, walking and Scott's spleenwort. One plant of Scott's spleenwort we believe to have been "born" at Tupper. We saw it first in 1966 growing with an ebony. Characteristically, it had tucked itself away out of sight around a corner of the cobble. It had not been planted there. Another plant of Scott's spleenwort we call the "Three Year Watch." We found it growing in the wild, so tiny that there was some argument whether it *was* a Scott's. We watched it for three years in its native home and there was no evidence of growth or change. In the fall of 1965 it was transplanted to Tupper Hill, and the next summer it decided it liked its new home and put on new growth. This year it has eight fronds.

(*Continued*)

Marjorie J. Dietz

The Christmas fern is one of the most adaptable ferns for garden conditions.

Molly Adams

The lacy maidenhair fern thrives in gardens but requires moist, humus-rich soil.

"The Cheilanthes Cobble is still under construction. Part of it is made of limestone rocks and part of native stone. Growing in it is the hairy lip fern, *Cheilanthes lanosa,* in limestone and apparently very happy. In the native stone we have planted *Cheilanthes tomentosa.* Eventually we hope to show other species of *Cheilanthes* in this cobble."

Building a Cobble

These two cobbles, as well as other cobbles at Tupper Hill, have been built by Mr. Fred Anderson, who is the Director of Wildlife at the Sanctuary. Mr. Anderson has supplied the following information on cobble building:

"The newest cobble at Tupper Hill is roughly 75 feet long and 16 feet deep, but a lime cobble can be made any size at all, even small enough to fit into a suburban wild garden.

"The ideal location is at the toe of a slope, so moisture will seep down from the top. The best slope is a three-and-one grade; that is, it rises one foot for every 3 feet. Exposure should be due north or as close to this direction as possible.

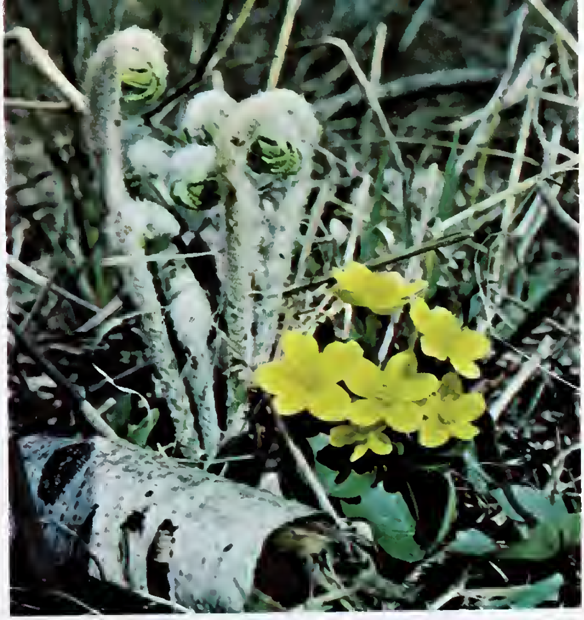
"To prepare the slope, take off most of the topsoil and undesirable debris and plant material, except for a few trees which can be left to provide shade. The trees can be thinned later as the new plantings become established and more light is needed. Here at Tupper Hill, we add field limestones or rocks, as porous as possible, and lime soil. Our soil mixture for lime-loving ferns contains about 2 parts loam, one part humus and one part talus. We spread the mixture to a depth of at least 6 inches and work hydrated lime (about one half pound to every 2 yards) into it thoroughly. Then the field stones are set firmly into the soil mixture, so they will not heave in frost action. We leave the "cobble" alone for a year to settle before adding plants.

"Once the cobble is planted, it should be watered twice a week until the plants are established and until there is certainty that the moisture seeping from the top of the slope is keeping the ground moist to a depth of 4 inches. An important point to remember when transplanting small rock ferns is to give them twice as much soil in which to grow as they had in the wild or seem to require in that state. Most wildflower nurseries can supply ferns, like the ebony spleenwort, walking fern and the cliff brakes, which are suitable for a cobble of any size."

Ferns at Tupper Hill

Blunt-lobe Cliff Fern—*Woodsia obtusa*
Bog Clubmoss—*Lycopodium inundatum*
Bracken—*Pteridium aquilinum*
Braun's Holly Fern—*Polystichum braunii*
Broad Beech Fern—*Thelypteris hexagonoptera*
Broad Shield Fern—*Dryopteris dilatata*
Bulblet Fern—*Cystopteris bulbifera*
Carolina Clubmoss—*Lycopodium carolinianum*
Christmas Fern—*Polystichum acrostichoides*
Cinnamon Fern—*Osmunda cinnamomea*
Common Polypody—*Polypodium vulgare*
Crested Wood Fern—*Dryopteris cristata*
Curly-grass Fern—*Schizaea pusilla*
Fragile or Brittle Fern—*Cystopteris fragilis*
Goldie's Wood Fern—*Dryopteris goldiana*
Ground Pine—*Lycopodium tristachyum*
Hartford Fern—*Lygodium palmatum*
Hay-scented Fern—*Dennstaedtia punctilobula*
Holly Fern—*Polystichum lonchitis*
Interrupted Fern—*Osmunda claytoniana*
Lace-leaved Grape Fern—*Botrychium dissectum*
Lady Fern—*Athyrium filix-femina*
Maidenhair Fern—*Adiantum pedatum*
Male Fern—*Dryopteris filix-mas*
Marginal Wood Fern—*D. marginalis*
Marsh Fern—*Thelypteris palustris*
Massachussetts Fern—*T. simulata*
Narrow-leaved Spleenwort—*Athyrium pycnocarpon*
Net-veined Chain Fern—*Woodwardia (Lorinseria) areolata*
New York Fern—*Thelypteris noveboracensis*
Northern Beech Fern—*T. phegopteris (Phegopteris connectilis)*
Oak Fern—*Gymnocarpium dryopteris*
Ostrich Fern—*Matteuccia pensylvanica*
Rattlesnake Fern—*Botrychium virginianum*
Royal Fern—*Osmunda regalis*
Running Pine—*Lycopodium complanatum*
Rusty Woodsia—*Woodsia ilvensis*
Sensitive Fern—*Onoclea sensibilis*
Silvery Spleenwort—*Athyrium thelypterioides*
Spinulose Wood Fern—*Dryopteris spinulosa*
Virginia Chain Fern—*Woodwardia virginica*

Native Ferns and Wild Flowers

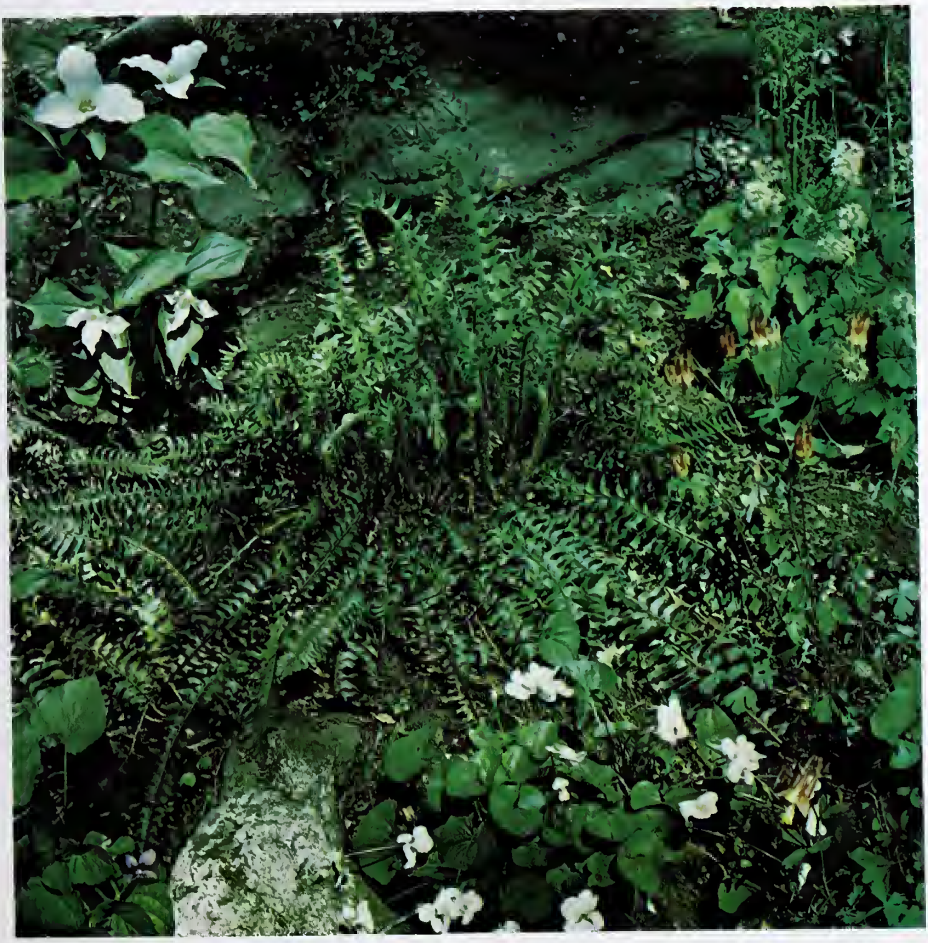


A welcome combination of early spring in wet woodlands is the yellow-flowered marsh-marigold (Caltha palustris) and cinnamon fern (Osmunda cinnamomea), shown here with fronds still furled.

Helen Hull

Violets, columbine, foam-flower and trillium surround a Christmas fern (Polystichum acrostichoides). The fern's new growth is in the center — the old evergreen fronds lie outside.

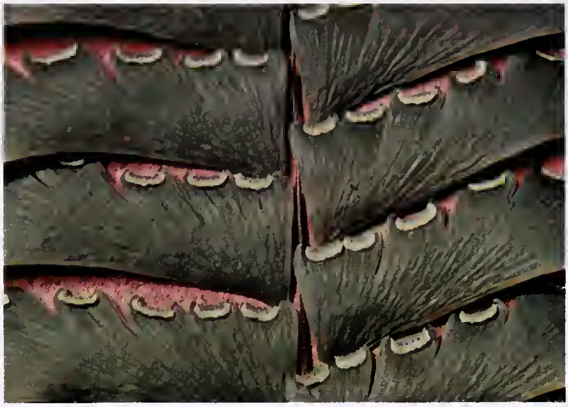
Roche



Ferns in the Garden

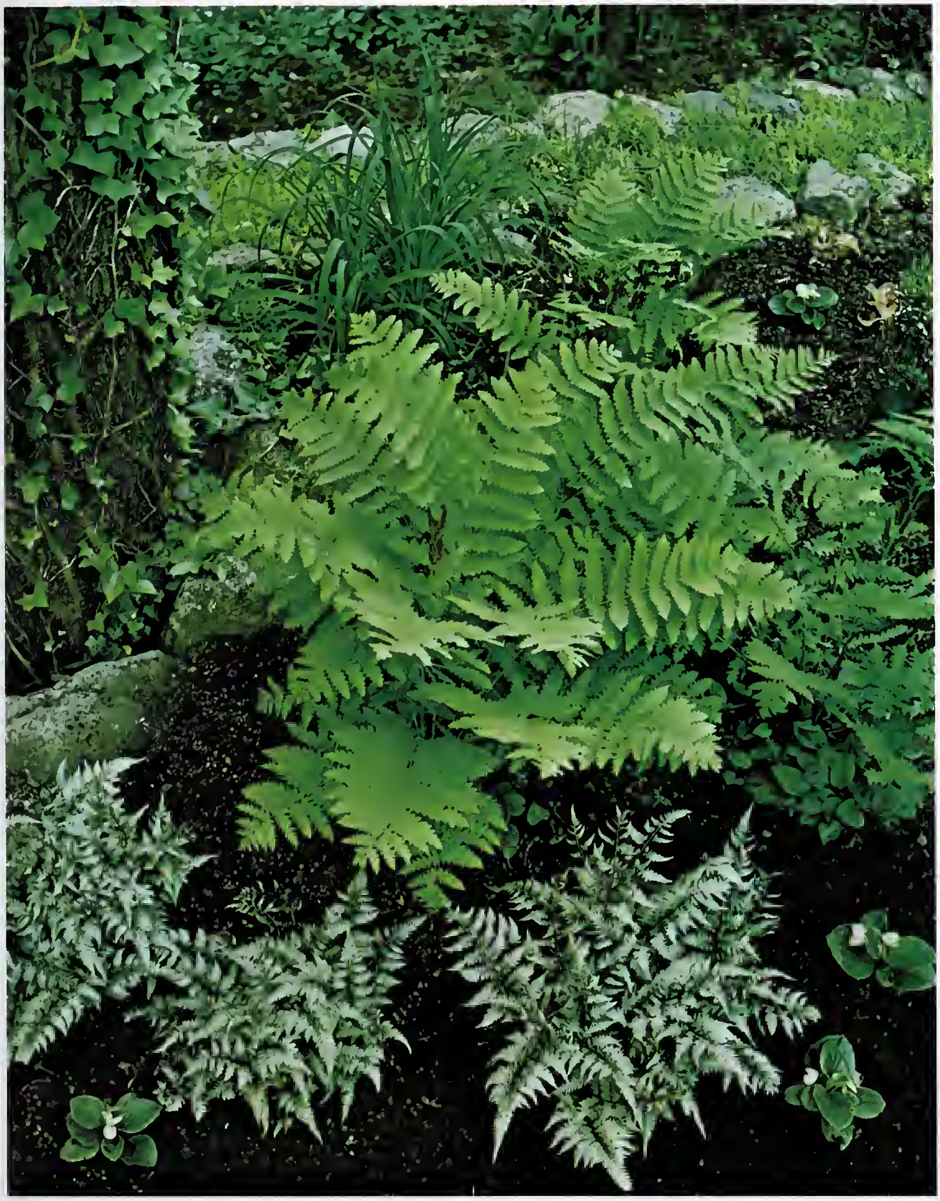
The beautiful maidenhair fern (Adiantum pedatum) is especially responsive to cultivation. Under good garden conditions — moist, humus-rich soil in light shade—the plants make luxuriant, graceful growth. Bleeding-heart (Dicentra spectabilis) is a colorful companion.

Photographed by Roche in Helen Hull's garden



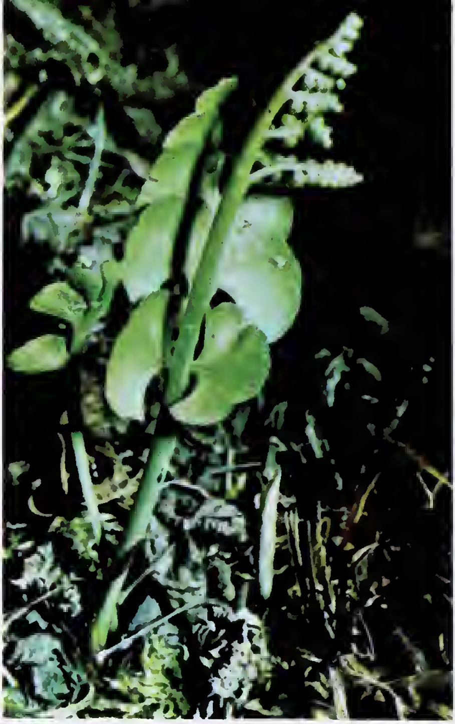
Close-up of maidenhair fern reveals fertile areas. The sporangia are covered by edges of leaflets.

F. Gordon Foster

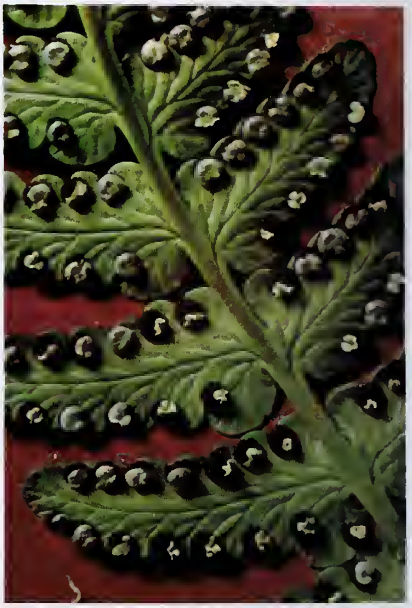


An adaptable native fern for shady gardens is the handsome interrupted fern (Osmunda claytoniana), which is shown above with the gray-green Japanese painted fern (Athyrium iseanum, formerly called A. goeringianum). Both are hardy, amenable species.

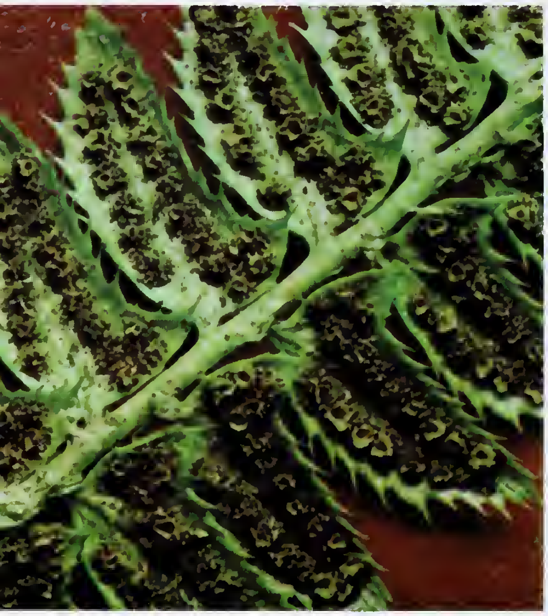
Photographed by Roche in Helen Hull's garden



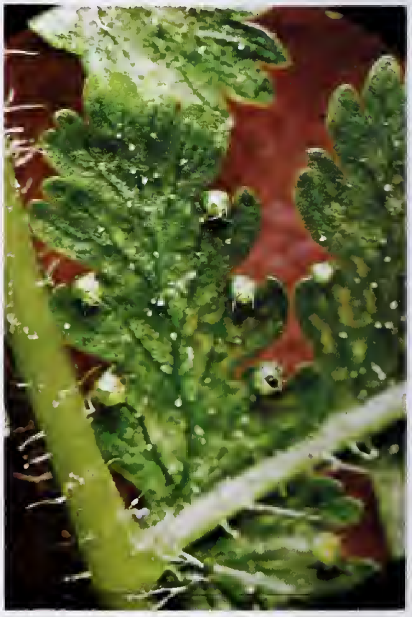
The sporangia-bearing stalk and half-moon-shaped leaflets of the fleshy moonwort (Botrychium lunaria).



Underside of leaf of marginal shield fern (Dryopteris marginalis) shows the mature sori and deep veining.



Underside of leaf of mountain holly fern (Polystichum lonchitis) shows rows of mature sori and spherical sporangia.



Enlarged leaflet of hay-scented fern (Dennstaedtia punctilobula) reveals cuplike sori, hairs and glands.

All photographs b
F. Gordon Foster

GROWING FERNS FROM SPORES

Mary C. Houghton

GROWING ferns from their spores is an inexpensive and highly rewarding hobby for the amateur pteridologist. For the conservation-minded it is particularly satisfying for by providing optimum growing conditions, one can actually increase the numbers of rare or exotic ferns. Inspired by an article in the *American Fern Journal* (July-Sept. 1961, pp. 113-127), written by our late beloved neighbor, Thorlief Fliflet, my husband and I have been experimenting for the past six or seven years. The rules are simple. Patience, rather than a green thumb, is the principal requirement, and elaborate equipment is not necessary.

Obtaining spores. Collect a fertile frond (or a few pinnae only of the larger ferns) at the approximate time of ripening (see the table) and place in an envelope. After the fronds (or the pinnae) have dried out and released the spores, usually less than a week if the fronds have been picked at the proper time, remove the pinnae and debris, leaving the powdery spores in the bottom of the envelope. You are now ready to prepare your containers for the sowing of the spores.

Containers for Sowing. The small, covered plastic containers sold for use as refrigerator dishes are well suited to our purpose. Because the plastic will not withstand boiling, wash in very hot water and dry with paper towels. Fill one-third to one-half full with washed vermiculite which is still wet. Add boiling-hot water to the same depth. Fill to within one-half inch of the top with woods soil (leaf mold) which has been strained through one-sixteenth–inch mesh and sterilized in the oven at 250° F. for 1 hour. Press the soil down and make smooth. Let stand until soil is saturated and cooled to room temperature. Now sprinkle the spores from the bottom of the envelope onto the moist earth in the container. Cover closely and

Hart's tongue ferns which have been grown from spores; 10 and 2 years old.

All photographs by Roche

Two male ferns and a Braun's holly fern raised from spores; all are 2 years old.

*Time Table for Spore Collection for Some Selected Ferns**

Adiantum pedatum (Northern Maidenhair Fern)	Aug—Sept
Asplenium platyneuron (Ebony Spleenwort)	Jul—Sept
Asplenium ruta-muraria (Wall Rue)	Jul—Sept
Asplenium trichomanes (Maidenhair Spleenwort)	Jul—Sept
Athyrium filix-femina (Lady Fern)	Jun—Sept
Camptosorus rhizophyllus (Walking Fern)	Jun—Sept
Cystopteris bulbifera (Bulblet Fern)	Jun—Aug
Cystopteris fragilis (Brittle or Fragile Fern)	Jun—Jul
Dryopteris cristata (Crested Wood Fern)	Jun—Sept
Dryopteris filix-mas (Male Fern)	Jun—Sept
Dryopteris marginalis (Marginal Wood Fern)	Jun—Oct
Dryopteris spinulosa (Spinulose Wood Fern)	Jun—Aug
Gymnocarpium dryopteris (Oak Fern)	May—Jul
Lygodium palmatum (Climbing or Hartford Fern)	Jul—Aug
Matteuccia pensylvanica (Ostrich Fern)	Jun—Aug
Osmunda cinnamomea (Cinnamon Fern)	Apr—Jun
Osmunda claytoniana (Interrupted Fern)	Apr—Jun
Osmunda regalis (Royal Fern)	Apr—Jun
Pellaea atropurpurea (Purple Cliff-brake)	Apr—Jul
Phegopteris connectilis (Thelypteris phegopteris) (Northern Beech Fern)	May—Jul
Phyllitis scolopendrium (Hart's Tongue Fern)	Aug—Sept
Polypodium virginianum (Common Polypody)	May—Jul
Polystichum acrostichoides (Christmas Fern)	Jun—Sept
Woodsia ilvensis (Rusty Woodsia)	Aug
Woodsia obtusa (Obtuse Woodsia)	May—Jul
Woodwardia virginica (Virginia Chain Fern)	May—Sept

*Adapted from Louise and James Bush-Brown, *America's Garden Book,* New York, Charles Scribner's Sons, 1947; page 997. Dates are approximate for areas where ferns grow naturally.

keep at room temperature; ignore except for a peek now and then until the spores have germinated.

Appearance of prothallia. The spores of most ferns will germinate in a few days or weeks, producing the flat, heart-shaped green prothallia, which are clearly visible to the naked eye. (However, I am currently discovering that the spores of the rare staghorn fern, *Platycerium alcicorne,* may take a good year to germinate! You can see that patience is needed to grow this fern.)

The prothallia, which maintain a state of arrested development until they are fertilized, can be given up to 20 hours of light a day, either indirect daylight or fluorescent light, and normal room temperature (about 70 degrees). The surface of the soil should be kept shiny-wet—if necessary use a fine spray to maintain wetness—to permit movement of the male cells (spermatozoa) within the prothallia.

At this stage I remove the plastic container covers, place the containers in a 5-gallon aquarium, and cover the tank with a sheet of plastic (a sheet of glass would be even better). This "terrarium"—a modified version of a Wardian case—is kept under a fluorescent light which is turned on by the first person up in the morning and left on until the last person retires at night.

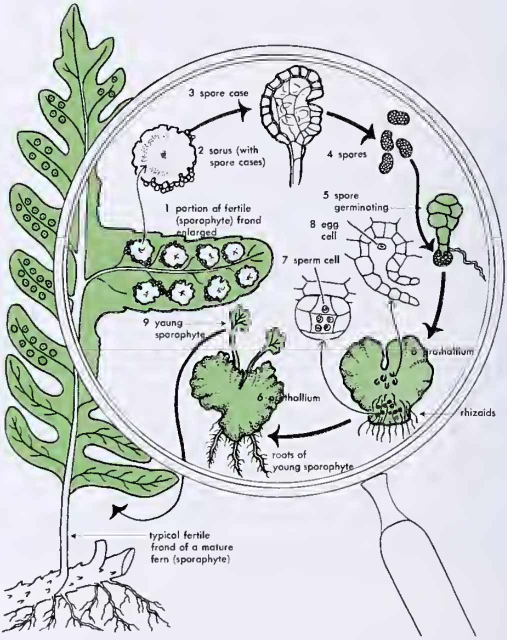
Appearance of sporophytes. After fer-

Fernlets of various ages are at rear in author's propagating box. In front row are Braun's holly fern; prothallia of staghorn fern; Christmas fern; and male fern. On the table are spores (in bag), and some fertile fronds of grape and staghorn ferns.

tilization of the egg by the sperm on the underside of each prothallium, there appear the sporophytes, the embryo ferns. (The prothallia disappear as the fernlets develop.) After about six months from the time of sowing the spores, most of the small ferns are large enough to be transplanted to flower pots. These, with a piece of crock in the bottom for drainage, should contain a sterile mixture of equal parts of leafmold, good topsoil and vermiculite. The young ferns should receive up to 20 hours of indirect daylight or fluorescent light daily and should be kept at normal room temperature. Mr. Fliflet recommends that the pots be kept in a terrarium or window greenhouse for about a year, but I have found that, with frequent watering, this is not necessary.

Planting out the young ferns. The young ferns should be ready to be planted outdoors in the second or third spring (from one and a half to two and a half years from the time of spore sowing), after all danger of frost is past. A cold frame or lath house, with some protection against direct sunlight, should be used. The young ferns should be kept adequately moist and should be mulched during their first winter out of doors.

Although there are other, more complicated procedures for growing ferns from spores than the one I have described here, we have found the above method quite satisfactory. It can, of course, also be used for growing the nonhardy ferns; merely omit the final step of transplanting them to the garden. In this category of tender ferns we have successfully grown the Southern maidenhair (*Adiantum capillus-veneris*), the Japanese holly fern (*Cyrtomium falcatum*) and the deer's foot fern (*Davallia canariensis*), among others. Of the ferns more or less indigenous to our area, we have been particularly successful with the blunt-lobed or obtuse woodsia (*Woodsia obtusa*), the male fern (*Dryopteris filix-mas*) and Braun's holly fern (*Polystichum braunii*). ◆


3 spore case
2 sorus (with spore cases)
4 spores
1 portion of fertile (sporophyte) frond enlarged
5 spore germinating
8 egg cell
7 sperm cell
9 young sporophyte
6 prothallium
6 prothallium
rhizoids
roots of young sporophyte
typical fertile frond of a mature fern (sporophyte)

Eva Melady

How a Fern Reproduces

TWO generations alternate in a fern's life cycle. The (1) sporophyte generaton is the stage at which the plants are most familiar to gardeners and nature lovers. It is the non-sexual "generation" of the plant. Small clusters of fruiting bodies (2), called sori, are formed on the under surfaces of fertile fronds. The sori consist of spore cases or sporangia (3), ~~single-celled organisms~~. Under favorable conditions, the spores (4) are dispersed and develop (5) into prothallia. Each prothallium is a green, heart-shaped plantlet, about ¼ of an inch in diameter, attached to the soil by rootlike, colorless rhizoids and containing microscopic male and female sex organs on the underside; these produce sperm (7) and egg cells (8). A mere droplet of water provides the means for the sperm to reach and fertilize the egg. When an egg cell is fertilized by a sperm, it divides and grows into the familiar fern plant (1 and 9). (Stages 4, 5, 7, and 8 can only be seen under a microscope.)

AN ILLUSTRATED DICTIONARY OF 43 USEFUL FERNS

HERE are forty-three ferns which have been selected for their suitability for homes and gardens. The compilation is based on personal experience, with corroboration from *The Fern Guide* by Edgar T. Wherry, *Ferns and Fern Allies of Minnesota* by Rolla M. Tryon, Jr., *The Gardener's Fern Book* by F. Gordon Foster, and *Ferns of Georgia* by Rogers McVaugh and Joseph H. Pyron. Dr. Wherry's botanical nomenclature has been followed here and throughout the Handbook.

Appearance indicates the habit of the fern: its height, width of the leaf, shade of green, and its form—whether it grows in vase form, as a mat or as single fronds along a creeping rhizome.

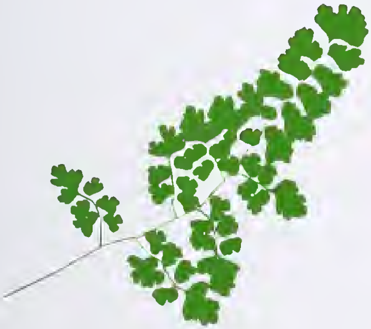
Range indicates in general where the fern grows in nature: "East" means states of the Eastern Seaboard; "West" indicates a range westward to the region named. Sporadic extensions of the general range are not included.

Culture covers the essentials for growing the fern: type of garden, soil, and other needs; whether the fern is a garden subject or house plant in cold climates.

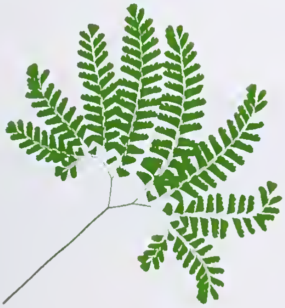
The neophyte pteridologist should supplement the brief notes in this list with additional information from the literature on ferns beginning on page 65.

The silhouetted fern drawings have been reproduced, with permission, from the *Gardener's Fern Book,* illustrated by F. Gordon Foster, and from *Ferns and Fern Allies of Minnesota,* illustrated by Wilma Monserud.

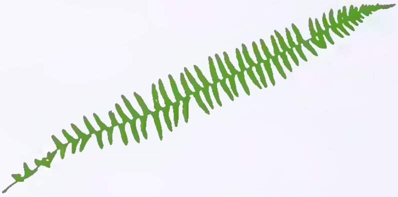
Helen S. Hull



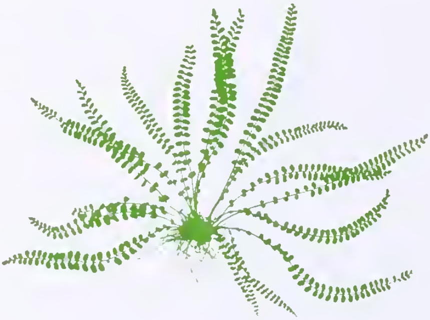
Adiantum capillus-veneris **Southern Maidenhair**
Appearance: Delicate. Drooping, light green evergreen fronds, usually less than 1 foot by 8 inches wide on bronze stipe. Considered most beautiful Southern fern.
Range: Subtropical regions and north to Virginia.
Culture: Loose woods soil with limestone added. House plant in North; in damp shade in South.



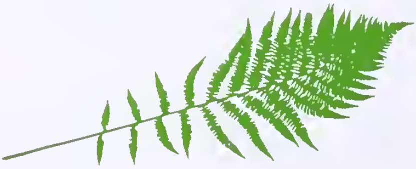
Adiantum pedatum **Northern Maidenhair**
Appearance: Light green; 1-2 feet, with horizontal, finely cut palmate blade. Said by Linnaeus to resemble a bird's foot, thus the specific term "pedatum." Black, wiry stipe from creeping rootstocks. A beautiful fern.
Range: In East and Midwest; south to Georgia and Louisiana.
Culture: Moist woods soil (add peat moss and/or leafmold to garden soil); appreciates limestone.



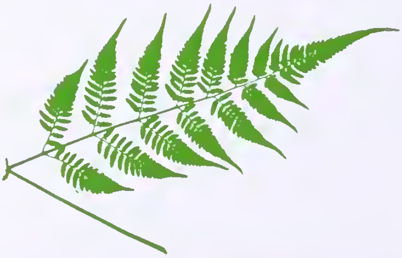
Asplenium platyneuron **Ebony Spleenwort**
Appearance: Erect, deep green fertile fronds 1 to 2 inches wide, 6 to 18 inches long, on "ebony" stipes. Sterile fronds are shorter and evergreen.
Range: In East, and south to Georgia; west to Iowa, Texas and Colorado.
Culture: Does well on limestone ledges in poor woods soil; also in subacid soil.



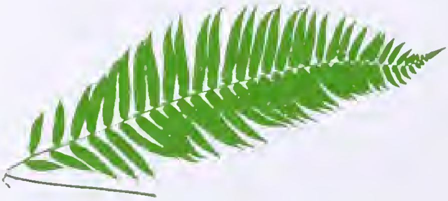
Asplenium trichomanes **Maidenhair Spleenwort**
Appearance: Evergreen rosette of 6-inch-long, thin and delicate dark green leaves on shiny dark rachis.
Range: Widely distributed; in East, and south to Georgia and Alabama; west to Alaska.
Culture: Soil pockets in limestone rock, but tolerant of other soils, other rocks. Requires shade and moisture. Grows sometimes on underside of rock or in the mouth of a cave. Rock gardens.



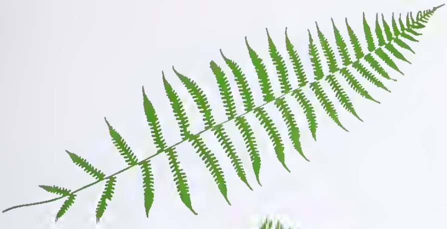
Athyrium filix-femina **Lady Fern**
Appearance: Feathery fronds 2 to 3 feet long, from creeping rootstock.
Range: Northeastern U.S., to Pennsylvania and Ohio. Several variants of lady ferns in North and South. Lowland or Southern lady fern (*A. asplenioides*) abundant in Georgia and from Florida to Texas.
Culture: Easy in woods soil in shady garden.



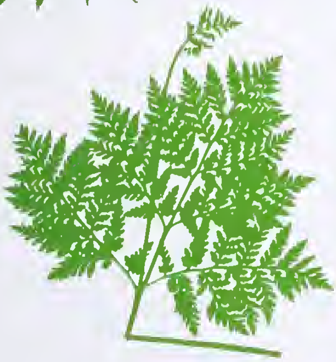
Athyrium iseanum **(Also called *A. goeringianum*) Japanese Painted Fern**
Appearance: One- to 2-foot gray-green fronds, shading to darker along purplish midrib. Deciduous. Pretty in front of taller plants.
Range: A native of Japan. Tardy in coming up in spring but hardy in the Northeast and similar areas.
Culture: Woodland garden. Multiplies easily by division.



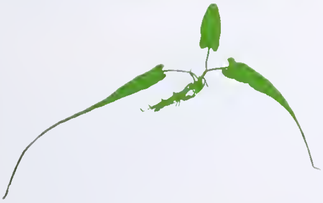
Athyrium pycnocarpon **Glade Fern; Narrow-leaved Athyrium**
Appearance: Bright green fronds 2 to 4 feet long, 6 inches wide from creeping rootstocks; during drought, turns brown.
Range: In East, ranging south to Georgia and Louisiana coast; west to Wisconsin, Kansas.
Culture: Easy in woodland garden, in rich woods soil.



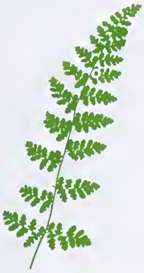
Athyrium thelypterioides **Silvery Glade Fern**
Appearance: Tall, brittle light green fronds, 2 to 3 feet, from slender rootstock.
Range: In East, and south to Georgia, west to Minnesota and Missouri.
Culture: Grow in soil rich in humus or in moist sandy soil. Good along stream banks in alluvial soil. Spreads.



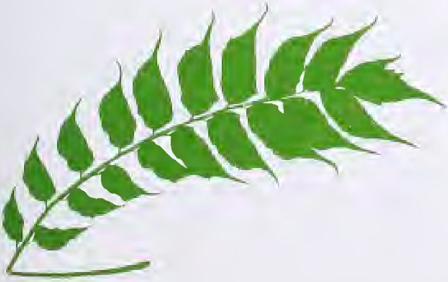
Botrychium virginianum **Rattlesnake Fern**
Appearance: One- to 2-foot, lacy, triangular, light green, horizontal blade with fertile panicle (the "rattle"), rising from stipe at junction with blade.
Range: In East, and across U.S. to British Columbia and California; south to Florida and Gulf states.
Culture: Moist woods soil in open shade. Protect against snails and rodents. Wherry cites twelve species and numerous variants of *Botrychium*, the "grape ferns," but culture is uncertain for gardens.



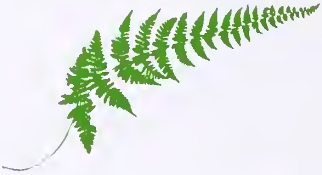
Camptosorus rhizophyllus **Walking Fern**
Appearance: Prostrate, 6-inch evergreen leaves, rooting at tip, thus "walking" to new location; also reproduces by spores.
Range: In East, and south to Georgia; west to Minnesota and Oklahoma.
Culture: Shady limestone pockets, in neutral woods soil. Protect against slugs.



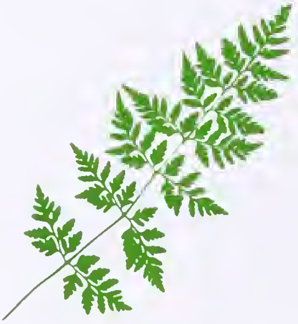
Cheilanthes lanosa **Hairy Lip Fern**
Appearance: Small, 6- to 8-inch lacy fronds; dense hairs on undersides. Grows in mats from creeping rhizomes.
Range: In the East, New York to Georgia; west to Minnesota, Kansas and Texas.
Culture: Protected area in neutral, moist woods soil. This rock fern curls when dry, but revives with rain.



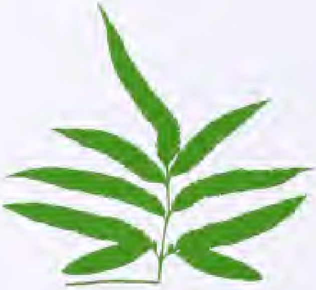
Cyrtomium falcatum **Holly Fern**
Appearance: 1- to 2 feet high, fronds are 6 inches wide; fronds 8 inches wide grow to 3 feet in South; evergreen. Shiny dark green leaves resemble some Southern hollies and *Mahonia*.
Range: Asian tropics and subtropics. Grows out-of-doors in Florida; tender in North and grown as a pot plant.



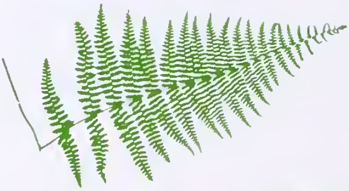
Cystopteris bulbifera **Bulblet Fern**
Appearance: Pale green leaves, 1 to 3 feet long and 3 inches wide, gracefully arching over limestone rocks.
Range: In East and West; in South to Georgia and Arizona.
Culture: Grow in shady rock garden. Spreads by bulblets in axils on underside of leaf which drop to ground and take root.



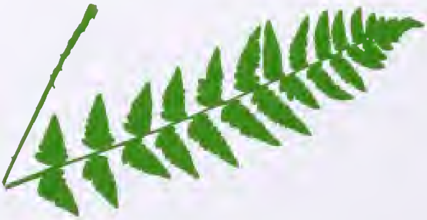
Cystopteris fragilis **Bladder Fern, Brittle Fern**
Appearance: Leaves 10 inches long, 3 inches wide; bright green croziers in early spring through summer.
Range: In East, and south to Virginia and Georgia; west to Minnesota, Missouri and Oklahoma.
Culture: For woods soil, open shade; moist crevices on rocky slope.
Note: *Cystopteris protrusa,* lowland brittle fern, was formerly considered a variety of above. It is a similar fern of easy culture in rock gardens.



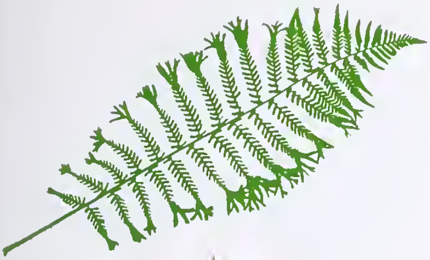
Davallia pentaphylla
Appearance: Deep green, 6- to 12-inch fronds from a hairy creeping rhizome. (The brown, almost furlike rhizomes which climb over the edges of pots give the *Davallia* species such common names as rabbit's foot or hare's foot fern.)
Range: Polynesia.
Culture: An epiphyte popular in pots, fern balls or baskets. Moist, neutral soil. Hardy in the South.



Dennstaedtia punctilobula **Hay-scented Fern**
Appearance: Deciduous light green, fragrant leaves, 2 feet long, 8 inches wide.
Range: In East, and south to Georgia; west to Minnesota and Missouri.
Culture: Grows in sun or shade; spreads in the garden.



Dryopteris cristata **Narrow Swamp Fern**
Appearance: Long, narrow and erect fertile leaves, 1½ to 2½ feet long, 3 to 6 inches wide; sterile evergreen leaves are 6 to 12 inches long and 2 to 5 inches wide.
Range: In East, and south to Virginia; west to Idaho, Arkansas.
Culture: Moist, loose woods soil. Good in shady garden where taller growth is needed.

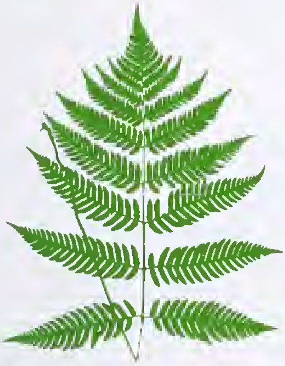


Dryopteris filix-mas **Male Fern**

Appearance: Fronds, up to 3 feet high and 9 inches wide, grow from crown. The one pictured here is a cultivated variety which originated in England.

Range: Newfoundland to Quebec, northwestern Vermont, northern Michigan. Also in Rocky Mountains. Rare; should not be dug.

Culture: Grows well in woodland garden in shade.

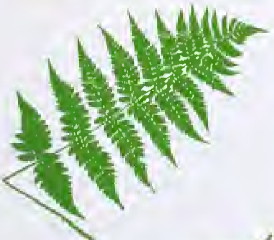


Dryopteris goldiana **Giant Wood Fern; Goldie's Wood Fern**

Appearance: Deciduous fronds, 3 to 4 feet or more tall, and 1 foot wide. Deep green, leathery.

Range: In East, and south to Virginia, North Carolina and Tennessee; west to Minnesota and Iowa.

Culture: Grows in woodland garden with woods soil. Mulch with leaves to maintain necessary soil moisture.

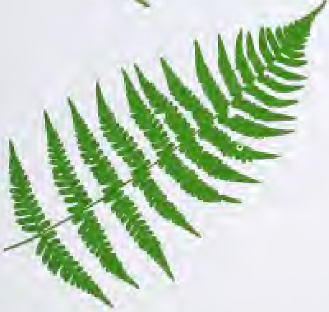


Dryopteris intermedia **Evergreen Wood Fern**

Appearance: Evergreen dark leathery fronds 2 feet long, 10 inches wide. Vase form.

Range: In East, and south to Alabama; west to Wisconsin and Missouri.

Culture: Rich, moist and rocky woods soil in shade.

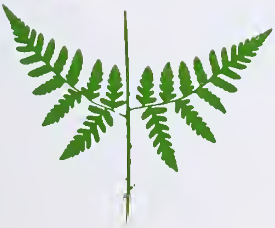


Dryopteris marginalis **Marginal Wood Fern**

Appearance: Dark green evergreen fronds 1 to 2 feet high and 6 inches wide grow from a crown.

Range: In East, and south to Alabama; west to Minnesota and Oklahoma.

Culture: Easy in woodland garden in well-drained woods soil; will grow on slope as ground cover.



Dryopteris spinulosa **Toothed Wood Fern; Spinulose Wood Fern**

Appearance: Deep green fronds, to 30 inches long by 6 inches wide; grow from crown. (Illustration shows basal pinnae.)

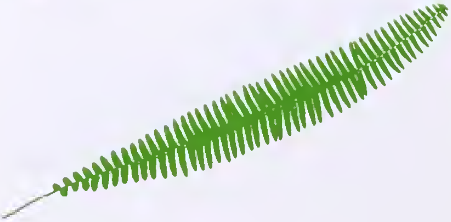
Range: In East, and north to Labrador; south to Virginia and North Carolina; west to Idaho and Missouri.

Culture: Rich, moist, stony woods soil.

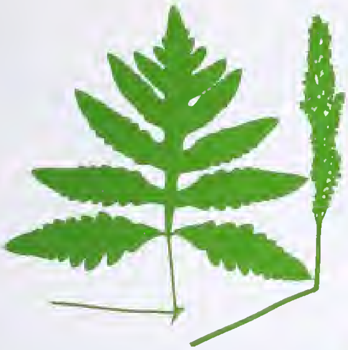
Lorinseria areolata **Net-veined Chain Fern**
Appearance: Glossy dark green fronds stand 2 feet high; each is 8 inches wide. The fronds are arranged along a creeping rhizome, somewhat resembling the sensitive fern.
Range: In East, and south to Florida; rarely, to Missouri and Michigan.
Culture: Native of bogs and swamps. It can be grown in shady gardens in acid, moist woods soil.
Note: This species is considered by some authorities to be *Woodwardia areolata.*

Lygodium palmatum **Climbing Fern; Hartford Fern**
Appearance: Twining and delicate fronds 4 to 5 feet long, with palmate leaflets.
Range: New Hampshire to Virginia and Kentucky.
Culture: Difficult. Needs acid, moist humusy soil. A related species, *Lygodium scandens,* a native of Japan, is easier to grow as a house plant.

Matteuccia pensylvanica **Ostrich Fern**
Appearance: Handsome, vase-shaped plant. Deciduous fronds, to 4 feet, are 6 inches to 1 foot wide from creeping rootstock.
Range: In East, and south to Virginia; west to Missouri, British Columbia.
Culture: Easy to grow in woods soil or on stream bank. Spreads rapidly in garden.
(Note: This is another fern which has gone through many changes in nomenclature. It has been known as *Pteretis nodulosa* and *M. struthiopteris;* it is still often listed under either name in catalogues.)



Nephrolepis exaltata **Sword Fern**
Appearance: Long, tapering blades, yellow-green to dark green, 2 to 4 feet long and 2 inches wide.
Range: Florida and the tropics.
Culture: As pot plant in North. There are many forms, including the ever-popular Boston fern. Grows on bases of trees in Florida, or on palm trunks. Needs moisture and sandy soil in sun or shade.

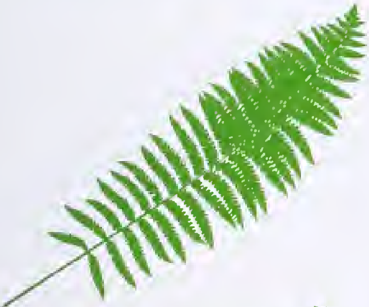


Onoclea sensibilis **Sensitive Fern**

Appearance: The coarse-cut, sterile blade stands 1 to 2 feet high. It grows in moist, sunny places. The fertile frond is compact, narrow, with sporangia in a panicle at top, giving one of the common names, "bead fern." Fertile fronds turn brown and persist over winter, but sterile fronds are first to wither with cold weather.

Range: In East, and south and west to Florida and Texas.

Culture: Spreads rapidly in moist situations.

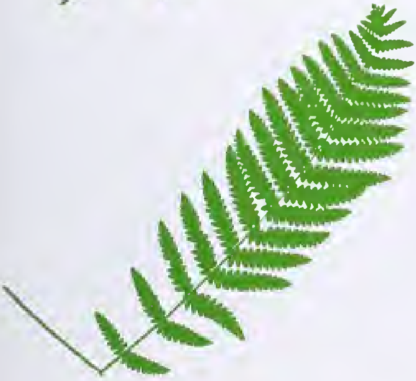


Osmunda cinnamomea **Cinnamon Fern**

Appearance: Large vase form, with fronds 2 to 5 feet long, 5 to 10 inches wide. Grows in swampy places in open woods. The cinnamon-brown fertile frond is separate.

Range: In East, and south to Florida; west to Minnesota, New Mexico.

Culture: Damp, open shade; good for larger gardens.

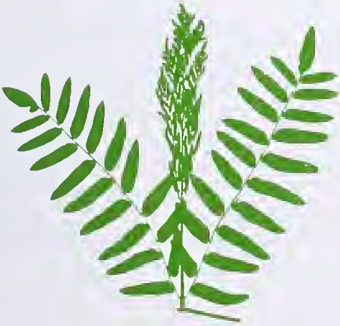


Osmunda claytoniana **Interrupted Fern**

Appearance: Fronds 3 to 5 feet long, 5 to 10 inches wide. Distinguished from the preceding species in that fertile blade is "interrupted" in middle by several pairs of fertile pinnae, darker green, which turn brown and wither.

Range: In East, and ranging west to the Mississippi River.

Culture: Easy in moist garden or woods soil in partial shade.

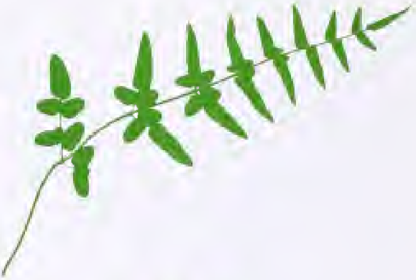


Osmunda regalis **Royal Fern**

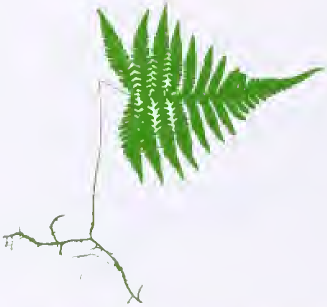
Appearance: Lovely, reddish-brown croziers unfold to 3 to 4 feet, with blades 1 to 2 feet wide. Fertile fronds bear clustered sporangia at top, giving common name of "flowering" fern.

Range: In East, and south to Florida; west to Minnesota and Texas.

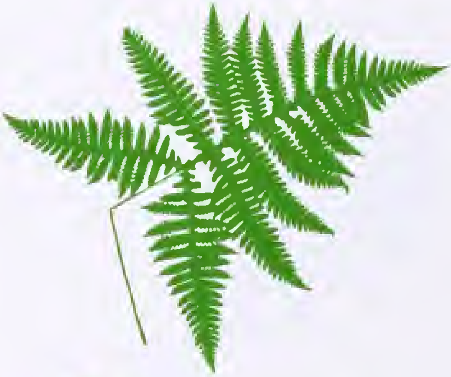
Culture: Requires more moisture than the two preceding species. Good for bogs, poolsides, stream banks. Does not spread rapidly and can be kept in bounds.



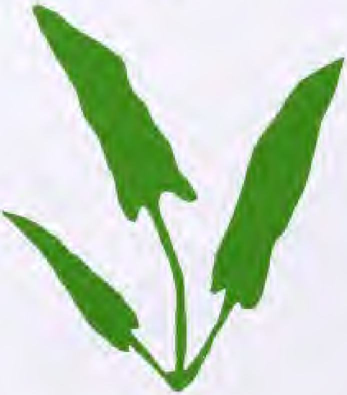
Pellaea atropurpurea **Purple Cliff-brake**
Appearance: Blue-green blade with purple-brown rachis stands 6 to 8 inches high, usually in pockets in limestone cliffs.
Range: In East, and south to Florida; west to Minnesota, to British Columbia and thence south.
Culture: Difficult to transplant, but a good subject in rock gardens with limestone and moist woods soil, neutral to slightly acid.



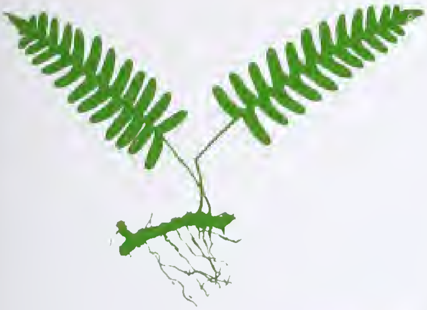
Phegopteris connectilis **(Also called *Thelypteris phegopteris*) Northern Beech Fern**
Appearance: Light green triangular leaves, 1 to 1½ feet high and 4 to 8 inches wide.
Range: In East, and south to Virginia and North Carolina; west to Minnesota and Alaska; also Iowa.
Culture: Easy in acid woods soil where roots can be kept cool and moist. May spread too rampantly from creeping rhizomes.



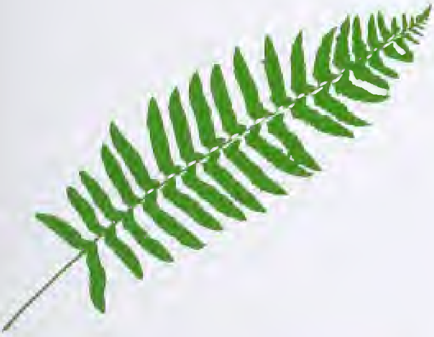
Phegopteris hexagonoptera **(Also called *Thelypteris hexagonoptera*) Broad or Southern Beech Fern**
Appearance: Triangular light green blade which bends gracefully forward when growing on wooded slope; standing 1 to 2 feet high and 8 to 16 inches wide at broadest point.
Range: In East, and south to Florida and Gulf states; west to Minnesota.
Culture: Spreads from shallow rootstock, but easily grown and desirable in woodland garden in moist woods soil. Excellent on slopes.



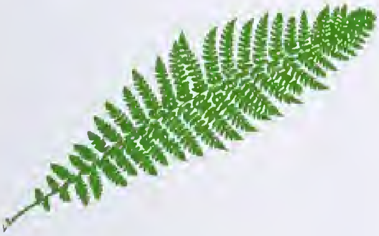
Phyllitis scolopendrium **Harts-tongue Fern**
Appearance: Evergreen blade, 6 to 18 inches long and 2 inches wide. Without the uncurling croziers visible, this would look more like a foliage house plant.
Range: New York mostly, but known occasionally farther north and in Tennessee. The European form (*P. scolopendrium*) is common in English and Irish gardens and is easier to grow in this country than is the American species.
Culture: Cool, moist root run, well drained. Difficult.



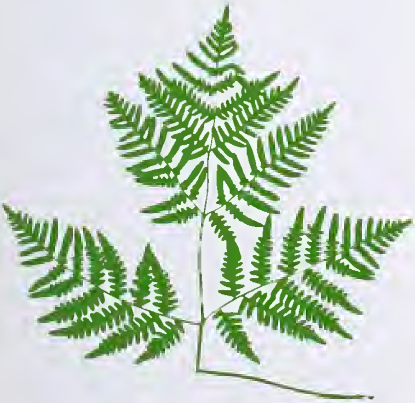
Polypodium virginianum **Common Polypody**
Appearance: Evergreen, leathery fronds 10 inches high and 2 inches wide. Grows in a mat on top of rock, thus its name "rockcap" fern.
Range: Across U.S. to British Columbia; south to Georgia and Arkansas.
Culture: Difficult to transplant from top of rock, but desirable for woodland rock garden; grow in humus, well drained but moist.



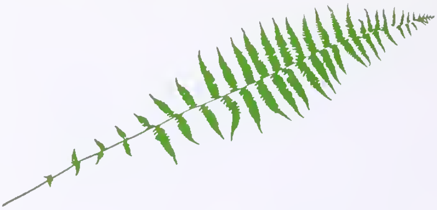
Polystichum acrostichoides **Christmas Fern**
Appearance: Evergreen leaves stand 1 to 2 feet high and are 2 to 4 inches wide, falling down around crown in spring as croziers appear.
Range: In East, and south to Florida; west to Wisconsin and Texas and Gulf states.
Culture: Desirable for garden in not-too-rich woods soil. It will grow on slopes in open shade.



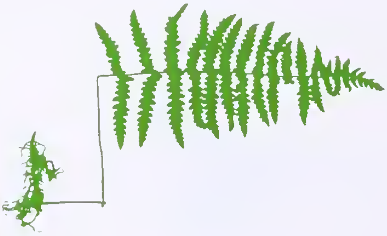
Polystichum braunii **Braun's Holly Fern**
Appearance: Deep green leaves up to 3 feet long and 8 inches wide. Handsome but not evergreen; grows from a crown.
Range: In East to Pennsylvania; west to Wisconsin.
Culture: Cool woodland soil that retains moisture.



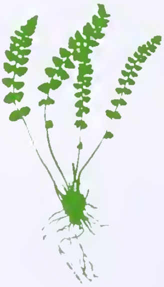
Pteridium aquilinum **Bracken; Brake**
Appearance: On 1- to 3-foot woody stipe is the coarse, dark green triangular blade, 1 to 2 feet long, and 1½ to 2½ feet wide. The blade bends over and shades soil. Thick rootstocks send up new fronds all summer.
Range: Throughout U.S.
Culture: Too rampant for small gardens but good cover for waste places in any kind of soil. It takes over where trees have been cut.



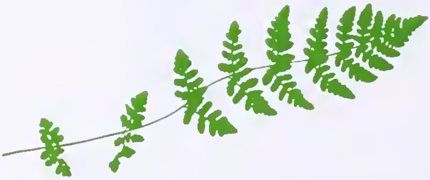
Thelypteris noveboracensis **New York Fern**
Appearance: Yellow-green fronds, 1 to 2 feet high and 3 to 6 inches wide, from cord-like root stock. Deciduous.
Range: In East, and south to Georgia; west to Minnesota and Arkansas.
Culture: Rich, moist woods soil in partial shade.



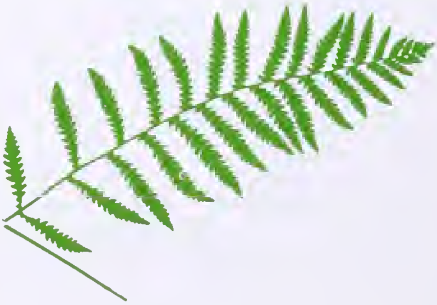
Thelypteris palustris **Marsh Fern**
Appearance: Light green blade stands 1 to 3 feet high, is 3 to 6 inches wide. Plant grows in marsh or meadow in sun.
Range: In East, and south to Georgia and Oklahoma; west to Minnesota but rare west of the Mississippi.
Culture: May spread too rapidly for small gardens, but good for stream and pond banks.



Woodsia ilvensis **Rusty Cliff Fern**
Appearance: This small fern, 3 to 6 inches high with delicate fronds only 1 inch wide, is distinctive although common. It is named from "rusty" hairs and chaff on the stipe and underside of blade.
Range: Across U.S. to Alaska and, in East, south through Pennsylvania to North Carolina; also Iowa.
Culture: Rock garden in open shade and loose neutral soil.



Woodsia obtusa **Blunt-lobe Cliff Fern; Obtuse Woodsia**
Appearance: Pale green leaf, 12 inches long and 2 to 4 inches wide.
Range: In East, and south to Northern Florida, Texas and Gulf States; west to Minnesota and Arizona.
Culture: Good for rock garden in open shade in neutral woods soil.



Woodwardia virginica **Virginia Chain Fern; Eastern Chain Fern**
Appearance: Dark green leaves may reach 3 to 4 feet.
Range: In East, and south to Gulf states; west to Michigan.
Culture: Native to bogs and swamps, rooting in mud, in sun; but rampant and spreading in the small garden. Use for waste places.

CONSTRUCTING A FERN COLUMN

Anne Ashberry

A FERN COLUMN to be covered by a glass dome can be made by planting a wire mesh tube with ferns (using very young plants), trailing plants and mosses.

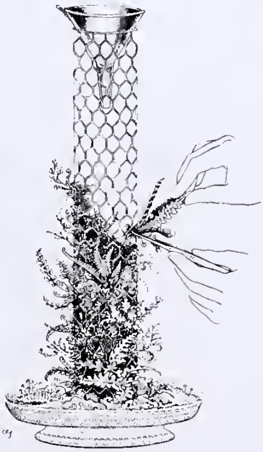
The tubing is made from a piece of half-inch wire mesh 9½ inches wide and 20 inches long, cut parallel with the reinforced edge. The jagged ends of the opposite side are bent into hooks and secured into corresponding holes. The column is then fixed to a flower pot with cement; this weights it.

The first stage in planting is to place a few pieces of charcoal, then to line the base a little way up the tube with moss, adding a little more charcoal. Next, pour in some humusy potting mixture made with an ample amount of peat. A cardboard tube is excellent for pouring in the soil and ramming it down. (Dampen the soil as layers are added.) Plant the first fern when there is about 2 inches of soil, gently poking the roots through the wire and leaving the fronds outside. Repeat the process of adding moss, soil and ferns, placing them so that there are ferns all around and all the way up at irregular intervals.

When the top is reached, plant a fern in the vertical position and bend the wire inward. Brush off surplus earth gently, moisten with a fine spray of water, and cover with the glass dome. Once established, the column will require only an occasional spraying. (*Editor's note*: Glass display domes may be obtained by mail from Downs, Evanston, Illinois 60204.)

© *Anne Ashberry*

Planting the fern column. It is filled in stages with moss, then soil, then plants, placed at irregular intervals.



All photographs from U.S. National Arboretum

Royal and cinnamon ferns growing together at edge of swamp in Fern Valley.

Where to see ferns:

THE NATIONAL ARBORETUM'S FERN VALLEY

Mrs. Christopher Granger

FERN VALLEY at the National Arboretum in Washington, D.C., reached its tenth birthday in the spring of 1969, and at the same time the developmental plan will have been completed. The purpose of this plan is to plant ferns, shrubs and wild flowers native to the northeastern United States as an educational, horticultural and conservation project. Plantings are designed to stress plant associations in ecological areas such as swamp, bog and lime rock, forest areas, dry banks and talus slopes. They are grouped for study and comparison (for example, members of the *Osmunda* and *Dryopteris* genera will be grouped) and to suggest effective use in home gardens as well as to encourage the preservation of native plants increasingly threatened by "progress."

How this came about can best be told by Dr. Francis de Vos, former Assistant Director of the United States National Arboretum. Without the strong interest and support of Dr. de Vos and Dr. Henry T. Skinner, the Director, the Fern Valley could not have come into existence. Dr. de Vos writes in the 1967 *Yearbook of the Department of Agriculture:*

"The little ravine had undoubtedly seen better days. The scarred stream bed told of past struggles with flash floods. The forest floor, now inhospitably carpeted in poison-ivy, sent the chance visitor on a different way. The remnants of a finer flora struggled with that naturalized alien from abroad, the Japanese honeysuckle.

"Yet somehow the ancient struggle of plant against plant and soil against water is forgivable, even when the end result is not to our liking. It was the hand of man that most defiled this ravine. The trash of his living was everywhere, scattered among the undergrowth—bottles, cans, and all kinds of ugly things resisting decay. This was Fern Valley at the National Arboretum in Washington, D.C., in 1959.

"But the beauty of this little ravine was restored, largely through the efforts of the National Capital Area Federation of Garden Clubs. How this was accomplished should be of interest to any garden club contemplating a beautification project, for most of the experiences common to projects of this kind were met and successfully resolved.

"Leadership, one essential element for success, came from an unanticipated quarter. In a class that I was teaching at the Arboretum on woody plants, there was a lady in her early eighties, Mrs. Edith Bittinger. When I mentioned that we were interested in developing a certain little ravine, she insisted on seeing the site immediately. From that moment we had the leadership we were looking for. The Fern Valley Committee of the National Capital Area Federation of Garden Clubs was soon organized with representatives from the federation and the American Fern Society and the Arboretum itself.

"Mrs. Bittinger provided inspirational leadership. Her chief lieutenant, Mrs. Margaret Donnald, whose name was to become synonymous with Fern Valley, provided the drive and the persistence to bring plans into reality.

"Early committee meetings clearly defined the limits of the 3½-acre site and established guidelines for its development. The natural vegetation of this valley would be preserved (except for poison-ivy) and enhanced with fern and wild-flower species of eastern North

Lady ferns by a fallen log.

America. Western and exotic species were to be excluded. The work priorities agreed on clearly recognized the need first to rid the valley of honeysuckle, poison-ivy and trash. They also determined how much working strength could be enlisted for the undertaking.

"When Arboretum representatives indicated they could provide little help aside from building trails, a small dam and a lime-rock retaining wall for lime-loving ferns, the garden clubs were fairly warned that acquisition of plants, planting and maintenence would be their responsibilities. The initial need for funds was satisfied when federation members of the committee outlined the proposed project before federation and individual garden club meetings.

"The events that followed the organizational meeting clearly indicated that the formula which led to the eventual success of the Fern Valley project was leadership, simple objectives and a hard core of devoted workers. The effective leadership of Mrs. Bittinger and Mrs. Donnald brought the project through the critical first stages. It has maintained a high level of interest and support.

"Having very simple objectives was extremely important, particularly in early phases of the project. The temptation to acquire and grow the unusual and difficult-to-raise native ferns and wild flowers was in great part resisted. Large patches of the easy-to-raise New York and Christmas ferns were soon established, and their most luxuriant growth spelled success and was the tangible evidence needed for increased support.

"The solidly established project then moved forward on many fronts. A self-guiding nature trail was established. A combination toolhouse and orientation shelter was erected. Plantings were elaborated and refined to demonstrate the major forest associations of the East Coast.

"The work went forward and continues to advance because leadership and planning assured the initial successes, and because it attracted a hard core of dedicated workers, who made themselves available when there was work to be done. There were times when they were summoned on short notice to rescue such choice items as royal ferns (*Osmunda regalis*) and the swamp azalea (*Rhododendron viscosum*) from the path of the bulldozer. At other times they were asked to be part of a planting, weeding or watering crew. Their tender, loving care brought planting plans to fruition and inspired others to emulate their efforts.

"The little ravine, now known as Fern Valley, is an enchanting place to visit at any time of the year. The towering oaks,

Beautiful silvery spleenworts (also called silvery glade ferns) growing beside a path.

beeches and tulip trees appear to approve of the changes that have taken place about their roots. In season, the hepatica, Virginia bluebell, lady's-slipper, cardinal flower, azalea, rhododendron and mountain-laurel decorate the forest floor. Ferns in many species hang from rocky crevices, carpet gravelly banks and keep company with swamp magnolias and cypress trees in the wetter places.

"The valley has been described by a nostalgic visitor as being like 'the woods back home.' To the hundreds of school children, who annually travel the self-guiding nature walk, all this presents an intimate and hopefully educational experience with nature."

Visitors to Fern Valley will enjoy masses of royal fern (*Osmunda regalis*), ostrich fern (*Matteuccia pensylvanica*), Christmas fern (*Polystichum acrostichoides*), marginal wood fern (*Dryopteris marginalis*) and silvery spleenwort (*Athyrium thelypterioides*). They will see flourishing colonies of New York fern (*Thelypteris noveboracensis*), maidenhair (*Adiantum pedatum*), broad beech fern (*Phegopteris hexagonoptera*), hay-scented fern (*Dennstaedtia punctilobula*), and sensitive fern (*Onoclea sensibilis*). Of special interest are clumps of the well-known lady fern (*Athyrium filix-femina*) and ebony spleenwort (*Asplenium platyneuron*); attractive areas of the less-familiar chain ferns (*Lorinseria areolata* and *Woodwardia virginica*) and Massachusetts fern (*Thelypteris simulata*); and handsome specimens of such showy wood ferns as the Goldie's fern (*Dryopteris goldiana*) and the crested fern (*Dryopteris cristata*).

Each year has brought increasing numbers of school children, groups of students and gardeners and those who come just to enjoy the beauty of the winding trail. And the coming years will bring continued growth, added interest and the unfailing support of the Arboretum and the corps of "women-weederers," who have learned so much, gained great satisfaction and lasting friendships through working in Fern Valley. ◆

MAKING A FERN TRAIL

Ruth H. Smiley

IF YOU are the kind of gardener who wants a fairly self-maintaining area, not too formal and with a long season of interest, the fern trail, or fern garden, is for you.

From early spring, when the first green croziers push up out of the dark earth, through the summer and fall months and even into winter, your green garden will be a delight. How can one justify the space for a green garden, you might ask. Just look closely at the beautiful tracery and delicate pattern of the fern frond and you will agree with Thoreau, who said that "Nature made the ferns for pure leaves to show what she could do in that line."

Look over your property with an eye to the needs of ferns and you may find that you have all the necessary conditions—shade, moisture, and a slightly acid soil. (There are, however, some ferns whose needs are different, among them the lime-loving varieties such as the fascinating walking fern and such sun lovers as the common hay-scented fern.) If shade is lacking, plant such small trees as dogwood, shadbush, witch hazel and sassafras and such shrubs as summer sweet, laurel and azalea. Too much shade is to be avoided when planting ferns; as can be seen in forests, undergrowth is sparse beneath luxuriant stands of pines.

Ferns Near Brooks and Pools

The blessing of a brook or pond on the property almost begs for the creation of a fernery along the banks. One of the most vital needs of most ferns is moisture, and if it cannot be provided naturally along a brook or pond side, it must be supplied by other means, especially during drought. (There are only a few ferns, among them the sensitive fern, the royal fern and the marsh fern, that like to keep their feet wet; others need moisture but good drainage, such as is supplied by woodsy soil or by crevices in rock.)

Develop your garden, then, along a brook or pondside if you can. When we created our fern garden here at Lake Mohonk, N.Y., a few seasons ago, we widened our brook at one place to make a little pool, encouraged the six or eight kinds of ferns already growing in the area, and added others until now more than 25 well-established varieties are to be found, labeled, along our fern trail.

To Establish a Trail

A good way to lay out a trail is to walk a winding route, allowing a heavy string or light rope to unwind behind you. Set your course to take advantage of existing clumps of ferns, and plan turns to provide the charm of surprise in coming upon an existing or to-be-planted clump. Your trail need not be extensive—its beauty will derive from its intimacy.

A garden, no matter how small, needs to be contemplated, and a rustic seat of logs or stone will help your "fern watching." Who knows, a tiny humming bird may pay a visit in the spring to pull the soft down from the osmunda ferns to build its nest in the trees above. So plan a spot for a resting place.

When you have the trail laid out to your liking, you are ready to grub out a path 3 feet wide. Lay down a layer of either gravel or wood chips—the wood chips are more pleasing esthetically but are sometimes hard to come by. Pull up the weeds from around existing fern clumps to encourage their spread.

Improve the soil, if necessary, where ferns are to be planted. The pH preferred by most is slightly acid, at about 6. Natural leafmold is the elixir of life for this ancient order of plants which was dominant on the earth 300 million years ago. As you scuff through leaves in a forest, you will note how cool and moist the lower, leafmold-rich layers remain, and how each year's falling leaves rot to form light humusy soil. So cherish any leafmold in your garden, and add to it—don't rake up the autumn leaves—leave them to add to the leafmold layer.

Once laid out, your fern walk can be continually under development as you add clumps that you have raised or purchased. The work can be done at any season when the ground is workable. Take care always to keep the fern clumps moist after transplanting.

A word of caution about collecting ferns from the wild: Many, if not all, are protected by conservation laws and should only be dug from a friend's property, with permission, where there is an abundance of the particular kind. (Sometimes conservation can be served, however, by a gardener who beats the bulldozer to an area about to be cleared.)

Inconspicuous labels may be added as the garden is established. They are helpful to visitors (and sometimes even to oneself, if one is the forgetful type!) Visit preserves and sanctuaries and then decide what kind of label suits you best.

Kinds to Plant

Although the pleasure of choosing ferns should be left completely to the gardener, a few suggestions may be helpful. A good beginning selection would include the hardy wood ferns, the New York fern, the maidenhair and the delicately patterned lady fern. Among the most adaptable to work with are the ferns of the osmunda group, especially the interrupted fern and the cinnamon fern.

If you are fortunate enough to have a wet or swampy section in the fern garden, there is nothing lovelier than a display of the royal fern, whose native habitat is swamps. The sensitive fern is happy with wet feet, too, but it is an eager grower and can soon take over, as will the handsome ostrich fern.

Rocky ledges and stone walls, if you have them, are for the little treasures, the spleenworts, the rues and the rock ferns. A limestone outcropping is for such gems as the walking fern and the cliff brake.

Only a sampling of ferns has been mentioned, for once the garden has been created, the joy of exploring for other ferns and experimenting with kinds that can be grown successfully will follow. Don't overlook the wild-flower nurseries as a source of a good variety of healthy, well-grown stock. And it will enhance the fern garden to tuck in wild flowers that are native or adaptable to your area, too; the fern foliage will be a perfect foil for the blossoms.

By all means visit nature preserves or sanctuaries, wild-flower gardens and botanic gardens in your area; they are sure to yield inspiration and ideas. ♦

To mark out a fern trail in woods, unwind cord or rope while walking.

Ruth H. Smiley

Juniper posts bearing plastic labels identify ferns that will exist along the trail.

FERNS IN THE LANDSCAPE

Robert Rucker

IN this day of changing concepts of landscape design, many new plants are being introduced and new uses for familiar plants are being explored. The ferns are among those regaining favor in contemporary landscaping. Ferns are most useful as seasonal and secondary plant materials. While they contribute to the landscape pattern, they are not strong enough in themselves to carry the weight of the basic design. They support the basic design by giving contrast in form and texture; they are all-important in plantings of intimate scale.

If one considers the principles of landscape architectural design—proportion, scale, balance, dominance, rhythm and contrast—it is clear that the ferns are very desirable, particularly in regard to scale and contrast.

Supporting the basic principles of design are certain others known as elements of design—line, form, texture, pattern, and color. It is in satisfying these design criteria that ferns come into their own. Their intricately patterned leaves, in endless forms and textures, make up a subtle symphony of green unsurpassed by any other group of plants.

The patterns created by contrasting the forms and textures of ferns are especially useful in contemporary design. Many new houses today include courtyards, atriums or other interior spaces lighted by the sky; these create micro-climatic environments which are suitable for a number of kinds of plants and are especially hospitable to ferns.

Because the entire courtyard environment has been modified by enclosure, it is often possible to grow ferns which would not thrive outdoors in a given locality. Where courtyard light is subdued or very limited, ferns adapted to low light intensity should be selected. Popular contemporary garden accessories such as stone and weathered wood are harmonious companions for fern plantings and are particularly effective with modern dwelling designs.

Some basic knowledge of ecological factors is essential to success with ferns; and, of course, well-grown specimens are essential if they are to carry design responsibility. The hardy ferns are a rather easy group with which to work. A light soil with sufficient humus to keep it loose and yet retain more or less constant moisture is desirable. Exposure of ferns in this group can vary from a few hours of full sun to light, partial, or even deep shade. Many ferns can tolerate dark locations and soggy soils, but certainly will not make their best growth under such conditions. Some ferns have a high tolerance of the dust and industrial fumes that may be present in the air of cities.

Many colonies of ferns are found in nature growing in crevices of rock or on pitted boulders and it is fairly easy to duplicate these environments in designing a landscape, especially where large amounts of stone are being used. For such plantings, choose species from a similar habitat to that being created.

Lush plantings of ferns create a nostalgic atmosphere of the forest, and this can be very successful in city gardens. Adding waterfalls, brooks or pools in naturalistic settings creates an environment for ferns and other plants, many quite exotic, that love high humidity; and of course such features give much esthetic pleasure.

There are many ferns from which to choose in landscaping, but there are certain ones with attributes that make them especially desirable. Among my own particular favorites are the beautiful maidenhair ferns (*Adiantum*), with delicate leaves borne on jet-black stems; the cinnamon ferns (*Osmunda cinnamomea*), which thrives in the shade and may reach a height of 6 feet; the interrupted fern (*Osmunda claytoniana*), 2 to 3 feet high, which tolerates dry, shady locations. ◆

Roche

Many ferns are tolerant of city conditions. The ostrich fern thrives in the shade of Russian-olive trees in the Kansas City garden of Mrs. Kenneth Spencer.

Decorative and Landscaping Effects with Ferns

In cold climates, many tender ferns, like this exotic relative of the Boston fern in an urn, make elegant terrace decorations. Other tender ferns are displayed in tall baskets on this shaded terrace.

Roche

Helen S. Witty

A tropical tree fern, a dramatic accent in the corner of the patio, towers over lower-growing ferns in garden of Mrs. G. W. Stroop Jr. in Pacific Palisades, California.

LITERATURE FOR FERN GROWERS

George H. M. Lawrence

FERNS GROWN IN THE GARDEN or conservatory are, for the most part, and unlike most cultivated plants, little modified by man from their counterparts in nature. For this reason much of the literature written by and for the botanist is applicable to the identification needs of the fern grower. However, to use most botanical accounts about ferns one must acquire familiarity with ferns' vegetative and reproductive structures and with the special terminology for them. Unfortunately, most botanical treatments—even though they provide good glossaries—fail to explain fern morphology adequately or in terms the non-botanist can comprehend. When accounts in other works fail to satisfy, the reader is referred to George H. M. Lawrence, *Introduction of Plant Taxonomy* (1955).

In the absence of any one book treating adequately the cultivated ferns of both garden and conservatory as found throughout both the continental United States and tropical Hawaii, one must assemble a working library of books selected to meet individual needs. In addition, there are other works—often more technical—to be consulted for special needs or for treatments of ferns native to restricted areas or countries. Works listed below are accordingly discussed in two groups: the fern grower's working library and the reference library. (Full citations of all book titles are given in a bibliography at the end of this account.

The Working Library

Despite their having been written more than 60 years ago, there are few more lucid and meaty accounts for the beginner of all aspects of cultivated ferns and their culture than those by Lucien Underwood, Nichol Bruckner, F. W. Barclay, and William R. Maxon, all in L. H. Bailey's *The Standard Cyclopedia of Horticulture* (pp. 1207-1219). Moreover, accounts of individual genera, given there in their alphabetic sequence, feature cultural notes pertinent to the particular genus. While the names of some ferns have changed since 1914-17, when most of these treatments were written, the cultural information remains essentially valid. (If one is to acquire a set of Bailey's *Cyclopedia* today, remember that except for a few typographical corrections made in the second edition of 1922, a set in three volumes dated 1968 is printed from the same plates as, and is no more up to date than, the six-volume set of 1914-17. A recent date on the title page is that of publication, not of the contents of the work.)

A short popular account of "Ferns in the Flower Garden" is that by H. Lincoln Foster in Boughton Cobb's volume, superbly illustrated by Laura Louise Foster, *A Field Guide to the Ferns* (1956). If one lives in the northeastern quadrant of this country and could have only two books on the native ferns of the region, this work by Cobb and that by Professor Wherry (*The Fern Guide,* 1966), which gives also a short paragraph on culture and nomenclature for each species, are my nominees. A critical review of Cobb's book by Professor Wherry and its defense by the late Ralph Benedict (see *American Fern Journal* 46:161-167, 1956; and 47:28-29, 1959) should be read by the serious fern grower who uses the book. Paul Penfield's defense of Cobb (*American Fern Journal* 55:139-141, 1965) also deserves reading. Wherry's more recent volume, more up to date and informative in its nomenclature, was well reviewed by Rolla Tryon in the same journal (52:89-90, 1962). Persons in the southeastern states will find Wherry's *The Southern Fern Guide* (1964) to be equally useful (but see the note appended to the entry in the bibliography below.)

Fern-garden enthusiasts as well as the beginner will find F. Gordon Foster's *The Gardener's Fern Book* (1964)to be a very useful guide, both for its text and the color and black-and-white illustrations. Primarily a work on fern culture, it is limited to treatments of 40 of the more common hardy ferns and 27 of the tender kinds. Somewhat older, but with very useful content, is the New York Botanical Garden's bulletin, edited by Carol Woodward, on *Hardy Ferns and Their Culture* (1940). One should not overlook the chapter on ferns in Helen Hull's *Wild Flowers for Your Garden* (1952), with its descriptive list of useful kinds.

Another book, of special value to persons growing the frost-tender ferns and useful for its abundance of superb reproductions of photographs, is Alfred Byrd Graf's *Exotica 3* (1963). No other modern work approaches it in the number of tender fern species illustrated.

Every serious grower of ferns will find the *American Fern Journal,* a quarterly devoted to ferns published regularly since 1911, to be an invaluable source of reliable and readable information on all aspects of pteridology (the science of ferns). A selection of papers of the last decade that are important to the fern grower follows:

Atkinson, Lenette R. "*Schizaea pusilla*—Perennial Gametophyte?" 55:81-83, 1965.—Includes cultural notes.

Bartho, Nicholas. "Experiences in Raising Ferns from Spores" 54:152-154, 1964.

Benedict, Ralph C. "*Botrychium* Transplanting?" 51:49, 1961.

———. "Ferns in the Florists' Trade in 1964" 54:206-207, 1964.

Bittinger, Edith. "The Fern Valley at the United States National Arboretum" 51:161-173, 1961.—In Washington, D.C. Illustrated.

Britton, Donald. "The Problems of Variation in North American *Dryopteris*" 51:23-30, 1961.—Includes bibliography.

Drummond, W. C. "The Fern Dell, Los Angeles" 49:2-9, 1959.—A four-acre fern garden of native and exotic kinds hardy in the area.

Farrar, Donald R. "A Culture Chamber for Tropical Rain Forest Plants" 58:97-102, 1968.—Includes bibliography.

Fliflet, Thorlief. "Growing Ferns from Spores" 51:113-127, 1961.—Includes bibliography. (*See also under* Knobloch.)

Hawkes, Alex D. "Florida Strap Ferns [*Campyloneuron* spp.] and Their Culture" 54:136-140, 1964.—By some authors retained in *Polypodium.*

Hoshizaki, Barbara Joe. "Ferns and Fertilizer" 58:49-53, 1968.

Huttleston, Donald G. "Fern Sources in the United States" 52:97-109, 1962.—Arranged by fern name, with sources for each.

Joe, Barbara. "Ferns Cultivated in California: *Sadleria*" 50:232-235, 1960.

———. "Cup Ferns (*Dennstaedia*) Cultivated in California" 55:58-62, 1965.

Johnston, J. W. "*Trichomanes holopterum* in Cultivation" 56:139, 1956.

Knobloch, Irving W. "Some Hints for the Fern Culturist" 54:73-76, 1964.—On growing ferns from spores. Includes bibliography. (*See also under* Fliflet.)

Krechniak, Helen B. "Native Ferns in a Tennessee Wild Garden" 56:26-29, 1966.

Leatherman, Sylvia. "Ferns in Cultivation" I. 49:116, 1939; II. 50:168-169, 1960; III. "Growing Fern Balls" 50:235-236, 1960; IV. "Some Wall Ferns." 51:174, 1961; V. "Growing Maidenhair Ferns" 52:83, 1962.

Lellinger, David B. "The Correct Name for the Button Fern [*T. gemmifera,* not *T. cicutaria*]" 58:180-181, 1968.

MacFadden, Fay. "Basket Ferns for Southern California" 51:186-188, 1961.

———. "Ferns for a Lath House" 51:129-131, 1961.

———. "My Lath House for Ferns" 51:65-67, 1961.—In Los Angeles.

———. "Remarks on the Care of Ferns in Cultivation" 53:155-158, 1963.

———. "Some Outdoor Ferns for the Los Angeles Area" 52:151-152, 1962.

Macself, A. J. "Feeding Hardy Ferns: Wise, Safe, and Risky Methods" 50:263-266, 1960.—Based on British environmental conditions.

Martin, Jesse T. "A Simple Method for

Growing Ferns from Spores" 55:179-180, 1965.

Morton, Conrad V. "Is *Thelypteris parasitica* in Cultivation in the United States?" 56:184-185, 1966.—Includes key to that species and to *T. dentata.*

———. "Observations on Cultivated Ferns" VII. "The Mother Ferns [*Asplenium* spp.]" 53:81-84, 1963.—Includes key and synonomy. VIII. "*Stenochlaena*" 55:164-166, 1965.

———. "Remarks on Some 1958 Dealer's Catalogs" 49:72-76, 1959.—*See also paper by* D. G. Huttleston.

———. "Some Fern Books for Different Regions of the United States" 50:169-178, 1960.—Full citations. Arranged by states; Alaska, but not Hawaii, is included.

———. "The Classification of *Thelypteris*" 53:149-154, 1963.—Includes bibliography.

Pratt, Waldo Todd. "Cultivating the Hartford Fern [*Lygodium palmatum*]" 52:64-65, 1962.

Russell, Helen Ross. "A Pteridophyte Botanical Garden" 55:63-66, 1965.—At State College, Fitchburg, Mass.

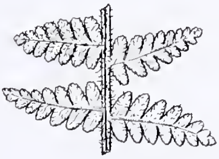
Tetley, M. I. "Growing Mother Ferns [*Asplenium*]" 54:94, 1964.— *See also* paper by Morton (1963).

Tryon, Rolla, and Tryon, Alice. "Observations on Cultivated Ferns: The Hardy Species of Tree Ferns (*Dicksonia* and *Cyatheaceae*)" 49:129-142, 1959.—Includes key to species.

Webster, Terry R. "Induction of Selaginella Sporelings under Greenhouse and Field Conditions" 57:161-166, 1967.

In addition to the papers listed above are the very useful papers on the identification of cultivated ferns by Mrs. Barbara Joe Hoshizaki of Los Angeles (who writes also under the name Barbara Joe) in *Baileya* (a quarterly journal of horticultural taxonomy published by the L. H. Bailey Hortorium, Cornell University) and in *Lasca Leaves* (published by the Los Angeles State and County Arboretum, Arcadia, California)—periodicals that are available at the libraries of most horticultural societies, botanic gardens and state universities. For her treatment of *Sadleria* and *Dennstaedia* grown in California gardens, see entries in the preceding list. Her papers in *Baileya* and *Lasca Leaves* are:

"*Pteris* Species Cultivated in California." *Lasca Leaves* 8:26-29, 1958.—Illustrated, with key; includes bibliography.



"Ferns Cultivated in California [*Woodwardia, Aglaomorpha, Pityrogramma*]." *Lasca Leaves* 8:60-65, 1958. [*Phyllitis, Doodia, Llavea*] 9:8-14, 1959. [*Cyrtomium, Onychium, Stenochlaena*] 9:61-67, 1959. [*Hypolepis,* contrasted with related genera] 9:74-75, 1959. [*Lygodium japonicum*] 10:86-87, 1960. [*Blechnum,* with key to cultivated species, *Ctenitis pentangularis*] 11:8-14, 1961.

"Species of *Dryopteris* Cultivated in California." *Baileya* 11:117-130, 1963.—Illustrated, with key.

"The Species of *Blechnum* in Cultivation." *Baileya* 8:102-117, 1960.—Illustrated, with key.

"Species of *Microlepia* Cultivated in California." *Lasca Leaves* 12:8-12, 1962.—Illustrated, with key; includes bibliography.

"Species of *Thelypteris* Cultivated in California." *Baileya* 11:99-110, 1963.—Illustrated, with key.

"The Bracken Fern [*Pteridium aquilinum*]." *Lasca Leaves* 13:88-89, 1963.—Its identity and use as an ornamental.

"Ferns Cultivated in California [*Asplenium*]. *Baileya* 12:19-27, 1964.—Illustrated, with key.

"Ferns Cultivated in California: *Tectaria.*" *Baileya* 12:47-51, 1964.—Illustrated, with key.

"A Review of the Species of *Platycerium*

(Polypodiaceae)" *Baileya* 12:69-126, 1964.—Illustrated, with key; includes bibliography. The best modern account of the genus, but see Morton, C. V., in *Baileya* 12:36-38 for correct name of *P. alciorne* (= *P. vassei*).

"Cultivated Tree Ferns of the Genus *Cibotium (Dicksoniaceae)*." *Baileya* 12:137-146, 1964.—Illustrated, with key. Includes bibliography.

The classification of ferns has never been stabilized by any consensus of professional pteridologists. It is unlikely that it ever can be. There is an increasing tendency to subdivide the large family Polypodiaceae into many smaller segregate families, a tendency that specialists in cultivated ferns and many botanists understandably accept with reluctance. Their positions in this matter range from the very conservative view of W. R. Maxon, in Bailey's *Cyclopedia,* to the moderate positions of Copeland, in his *Genera Filicum* (1947), and of R. E. Holttum in his *Ferns of Malaya* (1938.) Holttum also contributed most of the fern accounts in the latest (7th) edition of Willis' *Dictionary of Flowering Plants and Ferns* (1968), edited by Airy-Shaw. Here Holttum gives an excellent and concise summary of the history and current status of fern classification with references to supporting botanical accounts (pp. xiii-xv.) This dictionary is one of the better sources for information on the distinguishing characters for the families (and larger groups) of ferns. Brief accounts of the genera appear throughout the work in alphabetic sequence. Copeland's *Genera Filicum* is one of the best recent works, for it provides good generic descriptions of the ferns of the world, with keys for their identification, plus very readable notes and comments on nomenclature (with synonomy), distribution, size and importance. Although somewhat older (but available from dealers in second-hand books), Verdoorn's *Manual of Pteridology* (1938) is the most comprehensive interpretive summary of knowledge about ferns and is a keystone work for every serious student of ferns.

The Reference Library

Virtually every book in the fern grower's working library is based in part on more technical accounts to be found in the world's botanical literature, periodicals and books written in every modern language as well as Latin. Some of these works are useful to the more advanced and botanically inclined fern grower. Even the novice should know that they exist.

The distinctiveness of ferns, plus their being in a natural group apart from the flowering plants, has contributed to their having their own coterie of botanical specialists and their own literature. There are fern floras for most of the states and regions of this country (see reference above to Morton's bibliography in *American Fern Journal,* 1960) as well as for every major part of the world. Some of the more important of these (excluding those cited by Morton, 1960) are cited below. Not all are in print but they can be seen in botanical libraries. In addition, the more comprehensive floras of a country or region also include the ferns and are to be consulted when one is concerned with the ferns native to the area of coverage. For the northeastern states, see the treatments in Fernald, in Gleason, and in Gleason and Cronquist; for the southeast, those in Radford *et al.,* in Small, and in Wherry; for the Pacific area, those in Abrams, in Frye, in Hultén, and in Munz.

The adoption of different classifications of ferns by various authors often leads to placing species in one genus or another, thus causing a fern to be listed by one name in one work and by another elsewhere. This is disconcerting but unavoidable, since it is a matter of personal judgment as to whether a genus is to be treated as one including perhaps a hundred or more species or is to be broken up into several smaller genera. Whenever a fern is transferred from one genus to another, or when a large genus is reclassified into segregate genera, changes in name follow. Thus a single fern may have several names, each correct according to a particular concept. For the fern grower and the horticultural editor who want a single name for a plant, this is a frustrating situation. The most satisfactory solution is to adopt the treatment of a recent standard work that accounts for a majority of the genera concerned. If working with ferns from all parts of North America, consult Broun's *Index* (1938). If working with those of wider distribution, consult Bailey's *Manual* (Ed. 2, 1949) or *Hortus Second* (1940). The person more advanced in matters pteridological may wish to consult the taxonomic indices by Christensen (and its *Supplement* by Pichi-Sermoli) and by Reed.

Often one seeks illustrations of particular species or varieties of ferns. The index to sources of plant illustrations is Otto Stapf's *Index Londinensis* (1920-31, 1941). This is an index to those of the illustrations published from 1753 to 1935 whose captions include the Latin names of the plants depicted. It lists the ferns by the name used in the work cited, and the correctness of this name for the plant concerned is of course only as reliable as the author who used it in that instance. Copies of *Index Londinensis* are to be consulted at libraries of most botanical centers.

Selected Bibliography of Fern Literature

Note: For recent articles about cultivated ferns in the American periodical literature, see items cited in the text above. Few of the more classical color-plate works on ferns are included below; but they are to be found at leading botanical libraries. An accounting of those published up to 1880 is given by Jackson (1881).

Abrams, LeRoy. *Illustrated Flora of the Pacific States.* 4 vols. Stanford, Calif., Stanford University Press, 1923-61.—For the ferns see Vol. 1, pp. 1-50 (1923, rev. 1940). Every species is illustrated; keys and descriptions are provided. Taxonomic treatment is conservative.

Bailey, L. H. *Manual of Cultivated Plants Most Commonly Grown in the Continental United States and Canada.* Rev. Ed. New York, The Macmillan Company, 1949.—For ferns, see pp. 73-97. Includes keys and descriptions.

———. *The Standard Cyclopedia of Horticulture.* New York, The Macmillan Company, 1914-17.—For fern articles, see entries under Barclay, F. W., Bruckner, N., and Schmitt, X. E. E.; Maxon, W. R.; Schmitt, X. E. E.; and Underwood, L. M., and Benedict, R. C.

Baker, John G. *Handbook of the Fern-Allies. . . . Equisetaceae, Lycopodiaceae, Selaginellaceae, Rhizocarpeae.* London, George Bell & Sons, 1887. 159 pp.—Although this is no longer accepted as a natural group of the ferns, its treatment here is the only one in English of world-wide coverage. The identification and nomenclature of lycopodiums and selaginellas has changed considerably since this was written.

Barclay, F. W. "Ferns. Cultivation of Hardy Ferns." In Bailey, L. H. (ed.), *The Standard Cyclopedia of Horticulture,* 1915 (and subsequent "editions"), pp. 1216-1218.

Beddome, Richard Henry. *The Ferns of British India, Being Figures and Descriptions . . .* Madras, 1867[-70].—Includes 345 plates. This was followed by a second edition entitled *The Ferns of Southern India* [1872]-73, with 271 plates, and by *Handbook to the Ferns of British India, Ceylon and the Malay Peninsula* (Calcutta, 1883), with *Supplement* in 1892.

Brightman, Frank H., and Nicholson, B. E. *The Oxford Book of Flowerless*

Plants. London, Oxford University Press, 1966.

Broun, Maurice (comp.). *Index to North American Ferns. Constituting a Catalogue of the Ferns and Fern Allies of North America . . . Including All Known Forms, Varieties, and Hybrids.* Orleans, Mass., published by the compiler, 1938.—217 pp. A model of its kind, useful when seeking the correct name of a fern (as of 1938) when a synonym is in hand. A revised edition is needed.

Bruckner, Nichol, and Schmitt, Xavier E. E. "Ferns. Cultivation of Tender Ferns." In Bailey, L. H. (ed.), *The Standard Cyclopedia of Horticulture,* 1915 (and subsequent "editions"), pp. 1210-1213.

Christensen, Carl *et al. Index Filicum.* Copenhagen, H. Hagerup, 1906. *Supplement* [I], 1913; [II], 1917; [III], 1934. *Supplement* IV by Pichi-Sermoli, R. E. G., Utrecht, International Bureau of Plant Taxonomy, 1965.

Clute, Willard N. *Our Ferns: Their Haunts, Habits, and Folklore.* Ed. 2. New York, Frederick A. Stokes Company, 1938.—This a revised edition of Clute's *Our Ferns in Their Haunts* (1901).

Cobb, Boughton. *A Field Guide to the Ferns and Their Related Families of Northeastern and Central North America, with a Section on Species Also Found in the British Isles and Western Europe.* Boston, Houghton Mifflin Company, 1956.—281 pp. Illustrated by Laura Louise Foster.

Copeland, Edwin B. *Genera Filicum: The Genera of Ferns.* New York, The Ronald Press Company [1947].—247 pp.; 10 plates. Provides keys, descriptions and synonymy for the fern genera of the world.

Degener, Otto. *Illustrated Guide to the More Common or Noteworthy Ferns and Flowering Plants of Hawaii . . .* Honolulu, Honolulu Star Bulletin [1930].

Durand, Herbert. *Field Book of Common Ferns . . .* New York, G. P. Putnam's Sons, 1928.—Revised edition, 1949.

———. *Wild Flowers and Ferns: In Their Homes and in Our Gardens . . .* Rev. Ed. New York, G. P. Putnam's Sons, 1925.

Eaton, Daniel Cady. *The Ferns of North America. Colored Figures and Descriptions, with Synonymy and Geographical Distribution of the Ferns (Including the Ophioglossaceae) of . . .* 2 vols. Salem, Mass. S. E. Cassino, Publisher. 1879-80.—81 color plates.

Eifert, Virginia S. *Native Ferns of Eastern North America.* Ed. 3, rev. Toronto, Canadian Audubon Society, 1963.—64 pp.; illustrated.

Fernald, Merritt L. *Gray's Manual of Botany.* Ed. 8. New York, American Book Company [1950].—See pp. 3-50. Accounts for all species and variants of northeastern North America. Generic and family concepts are conservative; descriptions are technical but detailed and most reliable; keys to identification are excellent.

Foster, F. Gordon. *The Gardener's Fern Book: A Guide for the Gardener, a Reference for the Nature-Lover.* Princeton, N.J., D. Van Nostrand Co., Inc. [1964].

Frye, Theodore C. *Ferns of the Northwest Covering . . .* Portland, Ore., Oregon Metropolitan Press, 1934.—177 pp.; has bibliography.

Gleason, Henry A. *The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada.* 3 vols. New York, The New York Botanical Garden, 1952.—For ferns, written by C. V. Morton, see Vol. 1, pp. 1-56. Every species is illustrated, with descriptions and keys.

———, and Cronquist, Arthur. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada.* Princeton, N.J., D. Van Nostrand Company, Inc. [1963].—For ferns, see pp. 1-25, based on text by C. V. Morton. Excellent keys and descriptions. No illustrations.

Graf, Alred Byrd. *Exotica 3: Pictorial Cyclopedia of Exotic Plants. Guide to Care of Plants Indoors.* East Rutherford, N.J., Roehrs Co., 1963.—A sumptuous tome of 1,828 pages and 12,025 illustrations (291 plants in color). All families and genera of ferns treated are together under Filices, pp. 798-881, 1514. The descriptive treatments are given alphabetically by generic name.

Hemsley, Alfred. *The Book of Fern Culture.* London, J. Lane & Co., 1908.

Hibberd, Shirley. *The Fern Garden, How to Make, Keep, and Enjoy It.* Ed. 5. London, Groombridge & Sons, 1875.—148 pp.; 5 color plates.

Hires, Clara S. *Spores, Ferns; Microscopic Illusions Analyzed.* Milburn, N.J.; Mistaire Laboratories, 1965.—With 16-page *Supplement,* 1965.

Holttum, R. E. *A Revised Flora of Malaya . . .* Vol. II, *Ferns of Malaya.* Singapore, Government Printing Office [1954].—643 pp.; illustrated. A highly authoritative botanical account that includes also the ferns commonly cultivated throughout the tropics.

Hull, Helen S. *Wild Flowers for Your Garden.* New York, M. Barrows and Company, Inc. [1952].—See Chapter 7, "Ferns for Reverie," pp. 54-64, and annotated list.

Hultén, Eric. *Flora of Alaska and Yukon.* 10 vols. Lund, Sweden [Håkan Ohlssons Boktryckeri, 1941-50].—For ferns, see Vol. 1, pp. 12-77 [1941]. Keys, synonymy, distribution and habitats are given, but no descriptions or illustrations.

Jackson, Benjamin D. *Guide to the Literature of Botany.* London, Linnean Society of London, 1881. Reprinted by Hafner Publishing Co., New York, 1964.

Jones, George Neville. *An Annotated Bibliography of Mexican Ferns.* Urbana, Ill., University of Illinois Press, 1966.

Kaye, Reginald. *Hardy Ferns.* London, Faber and Faber, 1968.

Leatherman, Sylvia, and Behrends, Dorothy S. *Learn of Ferns We Grow.* Los Angeles, Calif., privately published, 1965.—For Southern California.

Lowe, Edward J. *Fern Growing. Fifty Years' Experience in Crossing and Cultivation, with a List of Most Important Varieties . . .* London, J. C. Nimmo, 1895.—196 pp.; portraits, color plates.

Maxon, William R. "Ferns as a Hobby," *National Geographic,* 47:541-586 (May) 1925.—Illustrated with 16 color plates.

———. "Ferns. Tree Ferns." In Bailey, L. H. (ed.), *The Standard Cyclopedia of Horticulture,* 1915 (and subsequent "editions"), pp. 1209-1210.

Mohlenbrock, Robert H. *Ferns* [The Illustrated Flora of Illinois]. Carbondale, Ill., Southern Illinois University Press [1967].—191 pp.; illustrated. Includes bibliographies.

Munz, Philip A., and Keck, David D. *A California Flora.* Berkeley and Los Angeles, University of California Press, 1959.—For ferns see pp. 21-47. Keys, descriptions and synonymy are given. Includes 4 figures. Treatment is conservative.

Parsons, Frances Theodora (Smith) Dana. *How to Know the Ferns: A Guide to the Names, Haunts, and Habits of Our Common Ferns.* Illustrated by Marion Satterlee and Alice Josephine Smith. Ed. 2. New York, Dover Publications [1961].—215 pp.

Radford, Albert E., Ahles, Harry E., and Bell, C. Ritchie. *Manual of the Vascular Flora of the Carolinas.* Chapel Hill, N.C., University of North Carolina Press [1968].—See pp. 3-34. Well illustrated, with good descriptions, keys and distribution maps.

Reed, Clyde F. "Index Selaginellarum," *Memorias Sociedade Broteriana* 18:1-287, 1966.—Available from the author, 10105 Harford Rd., Baltimore, Md. 21234.

Roberts, Edith A., and Lawrence, Julia R. *American Ferns: How to Know, Grow and Use Them.* New York, The Macmillan Company, 1935.

Sandford, E. *A Manual of Exotic Ferns and Selaginella, . . . Also Notes on Their History, Culture,* and *Management.* London, H. J. Infield [1882].—285 pp. The nomenclature is not always in accord with that of the present, but the descriptions and cultural notes are reliable. Not illustrated.

Schmitt, Xavier E. E. "Ferns. List of Tender Ferns." In Bailey, L. H. (ed.), *The Standard Cyclopedia of Horticulture,* 1915 (and subsequent "editions"), pp. 1213-1215.

Schneider, George. *Book of Choice Ferns for the Garden, Conservatory and Stove.* 3 vols. London, L. U. Gill, 1892-94.

Slosson, Margaret. *How Ferns Grow.* New York, Henry Holt and Co., 1906.—156 pp.; 46 plates.

Small, John K. *Ferns of Florida.* New York, The Science Press, 1931.—237 pp. The nomenclature follows directives of the now rejected American Code. For contemporary equivalents consult Broun.

———. *Ferns of the Southeastern States.* Lancaster, Pa. [The Science Press], 1938.

———. *Ferns of the Vicinity of New York.* Lancaster, Pa. [The Science Press], 1935.

Stevenson, Greta. *A Book of Ferns.* Ed. 2, rev. and enl. Hamilton, New Zealand, Paul's Book Arcade, 1959.

Taylor, Peter. *British Ferns and Mosses.* [London], Eyre and Spottiswoode, 1960.—231 pp.

Tilton, George H. *The Fern Lover's Companion: A Guide for the Northeastern States and Canada.* Melrose, Mass., pub. by the author [1922].

Underwood, Lucien M. *Our Native Ferns and Their Allies; with Synoptical Descriptions of the American Pteridophyla North of Mexico.* Ed. 6, rev. New York, Henry Holt and Co., 1900.—Includes bibliographies.

———, and Benedict, Ralph C. "Ferns." In Bailey, L. H. (ed.), *The Standard Cyclopedia of Horticulture,* 1915 (and successive "editions"), pp. 1207-1208.

Verdoorn, Frans (ed.). *Manual of Pteridology.* The Hague, Martinus Hijhoff, 1938.—640 pp.; illustrated. A comprehensive and interpretive summary of the current status of fern knowledge, including structure, growth, ecology, distribution, probable evolutions and classification of ferns. Each of these subjects is treated by a recognized authority, and the treatment of classification is by Prof. Christensen. For review see *American Fern Journal* 28:118-120, 1938.

Wakefield, Norman Arthur. *Ferns of Victoria and Tasmania.* [Melbourne], Field Naturalists' Club of Victoria, 1955.—71 pp. Based on *Victorian Ferns* by R. W. Bond and C. Barrett.

Wherry, Edgar T. *The Fern Guide. Northern and Midland United States and Adjacent Canada.* Garden City, N.Y., Doubleday and Company, Inc., 1961.—317 pp.; illustrated. The best current work for the region.

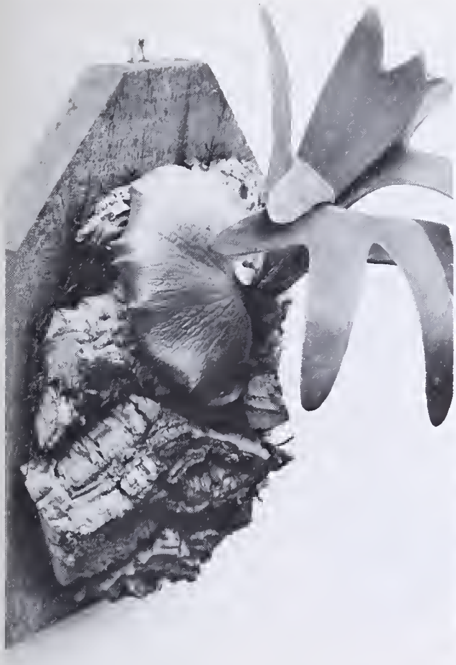
———. *Guide to Eastern Ferns.* [Ed. 2]. Philadelphia, University of Pennsylvania Press [1942]. Superseded by *The Fern Guide* (1961).

———. *The Southern Fern Guide.* New York, Doubleday and Company, Inc., 1964.—349 pp. Includes bibliography. A companion work to *The Fern Guide* (1961). Omits the higher-altitude ferns treated in the earlier work. Persons concerned with Southeastern ferns will need both books. Critical review in *American Fern Journal* 58:34-37, 1968.

Willis, J. C. *A Dictionary of the Flowering Plants and Ferns.* Ed. 7, by H. K. Airy-Shaw. London, Cambridge University Press, 1967.—Fern treatments by R. E. Holttum, basically on the generic concepts of Copeland's *Genera Filicum* and his own views as to the botanical circumscription of fern families and higher groups. For good review see *American Fern Journal* 58:142-143, 1968.

Woodward, Carol H. (ed.). *Hardy Ferns and Their Culture.* New York, The New York Botanical Garden, 1940.—A 40-page bulletin of contributed articles on all aspects of fern culture, including forcing and exhibiting. ◆

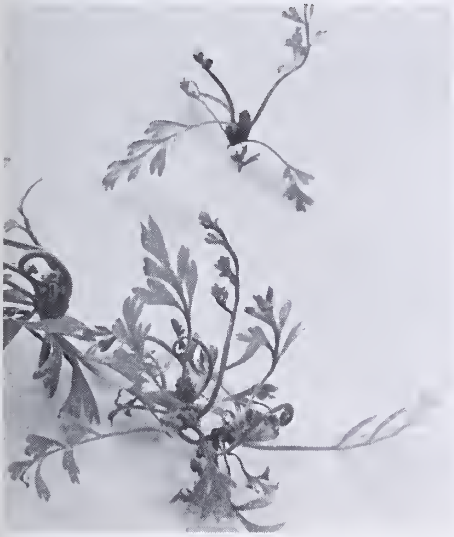
ODDITIES AMONG THE FERNS



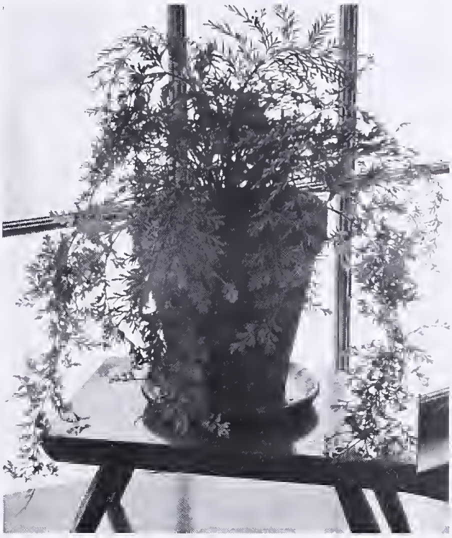
Staghorn ferns *(Platycerium)* are all epiphytes and grow well on bark slabs.

All photographs by Roche

A gastronomic delight, fiddleheads—ostrich fern croziers—being gathered.



Asplenium viviparum, as its name indicates, bears tiny plants from bulblets.



A mature *Asplenium viviparum* shows the graceful form of this non-typical fern.

The Cobble, a rare wild garden, is in an idyllic setting along the Housatonic.

A Massachusetts sanctuary for ferns and other native plants

BARTHOLOMEW'S COBBLE

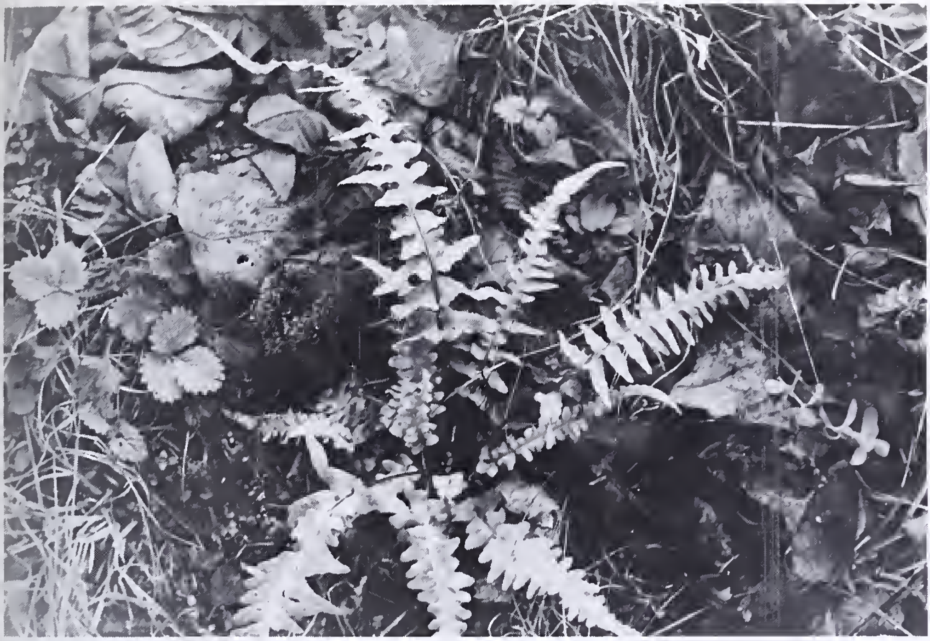
WHERE the Housatonic River meanders through the Berkshire Hills south of Sheffield, Massachusetts, two limestone and marble knolls have long been known as Bartholomew's Cobble—"Cobble" being an archaic Americanism for a rocky hill, especially one whose sides are covered with loose stones.

Once part of the colonial grant made to Col. John Ashley in a region where Indians had long farmed the riverside lands, the Cobble, covering 44 acres, has been owned since 1946 by the Trustees of Reservations, a privately supported organization that preserves beautiful and historic sites in Massachusetts.

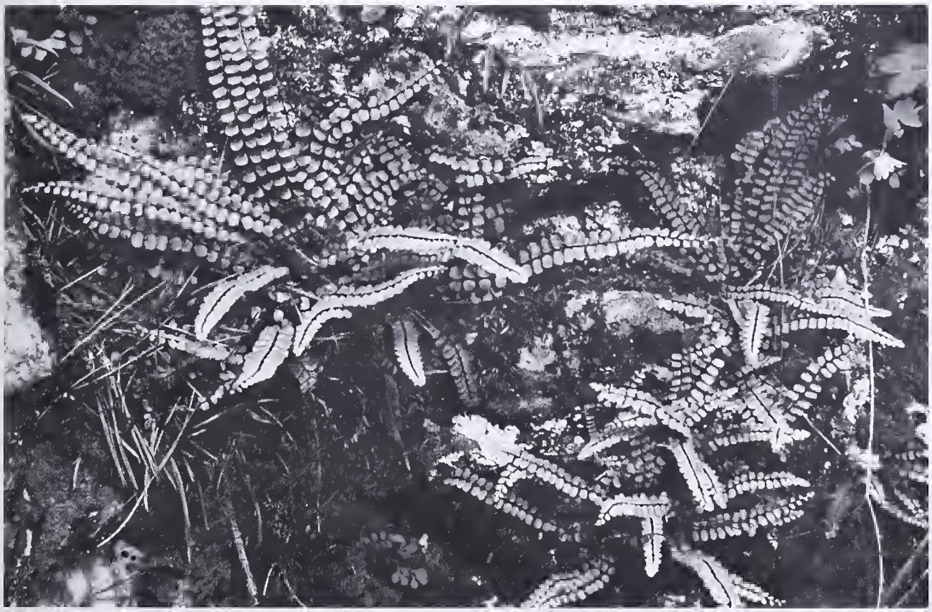
The Cobble's stone outcroppings, more resistant to erosion that the underlying rocks round about, have been a Mecca for botanists for many years; here is a rare wild garden of varied plant life. The soils vary widely from "sweet" or limy, in the limestone-ledge areas, to neutral and acid in the open and in the stands of hardwoods, pines, hemlocks and cedars, some very old. This variety of soils accounts for the 700 species of plant life, including mosses, lichens and mushrooms, that have been identified.

Among the 50-odd fern species are several rarely found on any but limestone soils. These include the maidenhair spleenwort; wall rue (*Asplenium ruta-muraria*); purple-stemmed cliff brake; and the walking leaf or walking fern, *Camptosorus rhizophyllus.* A great rarity is Scott's spleenwort, *Asplenium ebenoides,* a hybrid between the ebony spleenwort and the walking leaf.

A handbook is available, as is a trail guide who will point out features of interest. There is a nominal entrance fee. (*Directions*: On Route 7 at Ashley Falls, south of Sheffield, Mass. ◆



One of the Cobble's rarities is the hybrid Scott's spleenwort, *Asplenium ebenoides,* whose parents are the ebony spleenwort, *A. platyneuron,* and the walking leaf, *Camptosorus rhizophyllus.* See also photograph on page 34.



One of the ferns growing in greatest profusion among the limestone ledges and outcroppings is the maidenhair spleenwort, *Asplenium trichomanes.*

FERN TERMS

Blade—expanded portion of a fern frond, or leaf.

Crested—describes a forked tip of blade and/or pinnae.

Crozier—coiled frond or "fiddlehead," the form in which leaf emerges from soil.

Dimorphic—having sterile and fertile fronds differing in appearance.

Entire—leaf not divided or notched; same as simple.

Epiphyte—fern growing on another plant, but not parasitic.

Fern—flowerless, seedless plant, having root, stem and leaves and reproducing by spores. Some also reproduce vegetatively.

Fertile frond—a spore-bearing frond.

Frond—fern leaf, or "blade and stipe."

Glabrous—smooth.

Glaucous—covered with bluish bloom.

Hirsute—hairy.

Indusium—tissue covering a sorus or spore case.

Midrib—the central vein of a frond or of a leaf division.

Palmate—like the palm of the hand with fingers extended.

Pinna—a division of a blade; a leaflet of a pinnate frond (plural: pinnae).

Pinnate—resembling a feather in having similar parts arranged on opposite sides of the rachis. Blade is cut to the rachis. *Twice-pinnate*—Blade cut to rachis, and pinnae cut to midvein. *Thrice-pinnate*—Pinnae again cut to pinules, divisions of a pinna.

Petiole—the stem from rootstock to blade. Same as stipe.

Prothallium—the spore-grown, sexual stage in the fern's life cycle. Usually a flat, green, heartshaped growth about ¼" diameter, on which eggs and sperm are produced. When fertilization has taken place, the fern plant grows.

Pteridophyte—the division of vascular plants comprising ferns and related species.

Pubescent—covered with soft hairs.

Rachis—mirib of blade; extension of the petiole, or stipe.

Rhizome—horizontal, usually underground stem.

Rootstock—underground stem; may be erect or creeping, roots grow downward from the rootstock.

Simple—undivided leaf; same as entire.

Sorus—a "fruit dot" or a cluster of spores.

Sporangia—spore cases, usually on the underside of the fertile frond.

Spore—tiny cell which may produce a prothallium.

Spore cases—same as sporangia.

Sterile—without spores.

Stipe—stalk of frond between rootstock and blade; same as petiole.

Fern Habitats

Acid soil—as opposed to alkaline. Blue litmus paper turns red in a moist soil sample. Soil test result is below 7 on the pH scale of 1 to 14.

Alkaline soil—as opposed to acid. Red litmus paper turns blue in a moist soil sample. Soil test result is above 7 on pH scale.

Bog—an open wet area, with no water outlet. Usually acid from decayed vegetation.

Circumneutral—soil testing from slightly acid to slightly alkaline; around pH 7.

Cobble—a small hill whose sides are covered with loose, or cobble, stones—a rocky knoll.

Humus—disintegrated or partially disintegrated organic remains of plants and animals in soil.

Marsh—open wet area often overgrown with grasses.

Muck—wet soil of organic remains of plants and animals.

Neutral soil—neither predominantly acid nor alkaline.

Swamp—a wet area partly grown up to trees and shrubs.

Talus—loose rocks at base of cliff.

SOURCES FOR FERNS

Edelweiss Gardens, Robbinsville, New Jersey 08691 (*Exotic ferns*)

Gardens of the Blue Ridge, Ashford, McDowell County, North Carolina 28603 (*Hardy ferns and wild flowers*)

Leslie's Wild Flower Nursery, 30 Summer Street, Methuen, Mass. 01844 (*Hardy ferns and wild flowers*)

Sky-Cleft Gardens, Camp Street Extension, Barre, Vermont 05641 (*Hardy ferns and wild flowers*)

The Three Laurels, Madison County, Marshall, North Carolina 28753 (*Hardy ferns and wild flowers*)

Wake Robin Farm, Route 1, Box 33, Home, Pennsylvania 15747 (*Hardy ferns and wild flowers*)

Thomas M. Wood, Constantia, New York 13044 (*Hardy ferns and wild flowers*)

Leatherman's Gardens, 2637 N. Lee Avenue, South El Monte, California 91733 (*Exotic ferns*)

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Logee's Greenhouses, Danielson, Connecticut 06299 (*Exotic ferns*)

Orchid Gardens, Route 3, Box 224, Grand Rapids, Minn. 55744 (*Hardy ferns and wild flowers; catalog 25 cents*)

Roehrs Exotic Nurseries, Rutherford, New Jersey 07070 (*Exotic ferns*)

Alberts & Merkel Brothers Inc., Post Office Box 537, Boynton Beach, Florida 33435 (*Exotic ferns*)

The Wild Garden, 8423 N.E. 119th, Kirkland, Wash. 98033 (*Hardy ferns and rare plants*). Catalog costs $1, deductible from first order.

Talnadge's Fern Gardens, 354 "G" St., Chula Vista, Calif. 92010 (*Exotic ferns*)

Mrs. E. Reed Brelsford, 1816 Cherry St., Jacksonville, Fla. 32205 (*Exotic ferns; no catalog*)

The fern fancier will also find it well worth while to join a fern study group. The Los Angeles International Fern Society, c/o Wilbur Olson, 13715 Cordary Avenue, Hawthorne, California 90250 provides monthly lesson sheets with emphasis on tropical ferns. The dues are minimal and much of the information cannot be obtained from any other source. The American Fern Society, c/o LeRoy K. Henry, Division of Plants, Carnegie Museum, Pittsburgh, Pa. 15213, Treasurer, has a publication which appears quarterly. This Society also conducts a spore exchange for its members.◆

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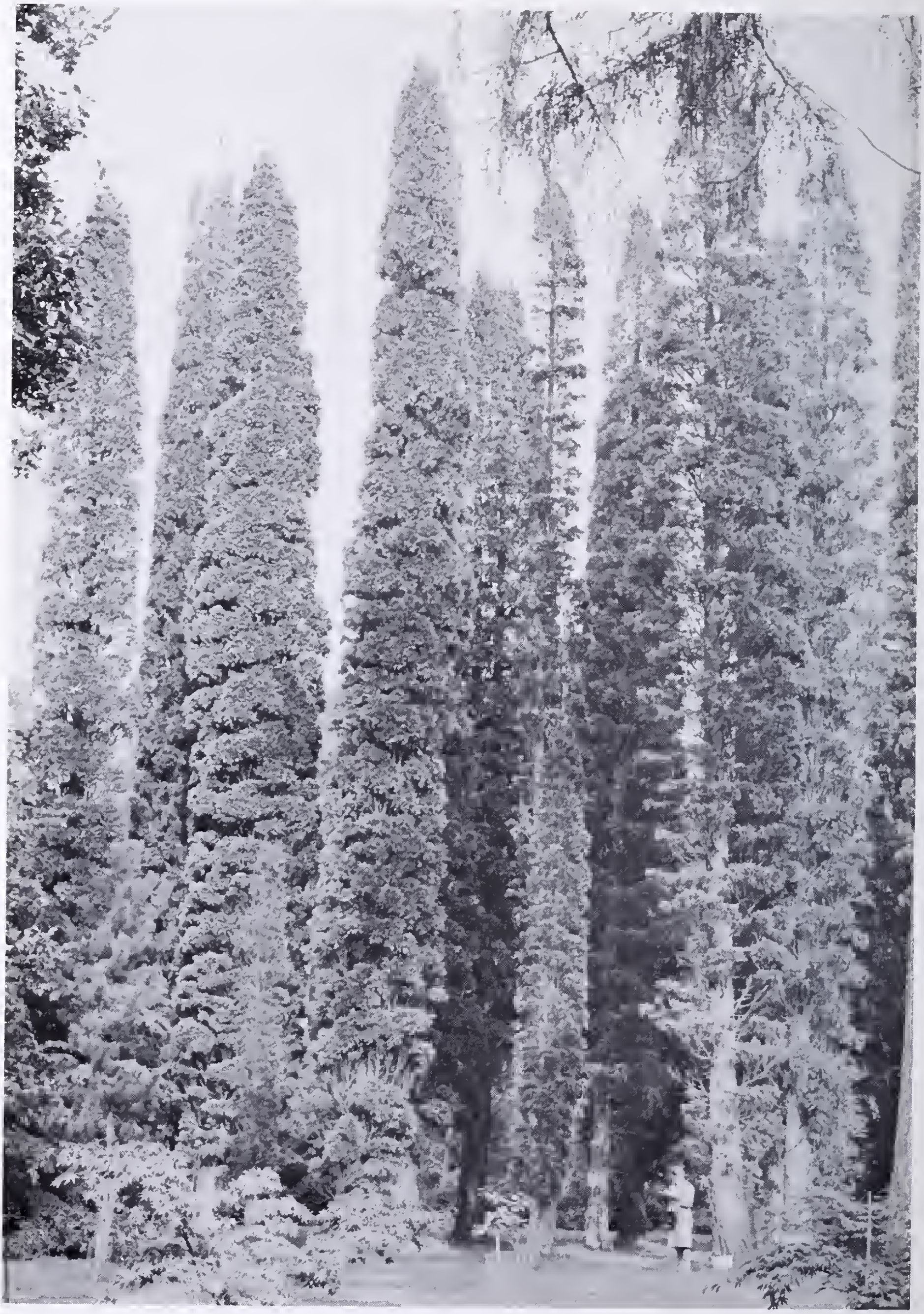

B. O. Mulligan

The famous group of Californian incense-cedars (*Calocedrus decurrens*) at Westonbirt Arboretum, England. It was formerly known as *Libocedrus decurrens*.

BROOKLYN BOTANIC GARDEN

The main focus of this Handbook is on the Pine Family and related cone-bearing trees, and Guest Editor Henry Teuscher has selected the fifty he considers the finest in the world for ornamental planting. From his life-long career as a scholarly and at the same time practical horticulturist, he is eminently qualified to make such a selection. Bear in mind that the Pine Family includes spruce, fir, larch, cedar and hemlock—as well as pines.

Not all the trees Mr. Teuscher has given top rating will thrive in any and every location, *e.g.*, some are not winter hardy in temperate climates. But for a guide to the finest, wherever they may grow, give his important lead article the weight that it merits. Having said this, let me humbly add that I questioned his selection of the red-cedar *(Juniperus virginiana)* and his omission of the Canadian hemlock *(Tsuga canadensis)*—but I defer to my respected friend of many years.

For guidance on the best (or most successful) conifers for the many different climatic regions in the United States, pay special attention to the selections made by experienced regional horticulturists (pages 34 to 49). And for broader horizons turn to the listing of conifers and where to buy them by Frederick McGourty, Jr., on pages 86 to 104.

Pine Family trees belong to the still larger botanical grouping called Gymnosperms. All of them are of ancient heritage, dating back a few hundred million years in the earth's history. The thousand or so species of Gymnosperms that grow in the wild somewhere on the earth today are but a living remnant of the once mighty gymnospermous forest that cloaked the land surface of our world. And in those geologically ancient times when the now arctic regions had warm climates, redwoods *(Sequoia sempervirens)* grew in Greenland and Iceland and across the north of Asia; so did the bald-cypress *(Taxodium distichum)*. Fossil remains attest to their presence in those areas. Today the native stand of the first of these species is restricted to a relatively small area in California, and the latter is found chiefly in the swampy areas of the southeastern United States—though a sister species grows in the wild in parts of southeast Asia. No longer aggressive, these species are destined for ultimate extinction unless the hand of man intervenes. It was presumably the priests in ancient China who preserved the ginkgo by planting it around their temples, for it may be unknown as a wild tree anywhere on earth today. And metasequoia, as most readers will know, was well on its way to being lost to the world as a living species when it was found deep in China in 1941.

Today our common concern is for the beauty of the world we live in and the contribution we can make to it—as individuals and collectively. We can "scatter our shots" and achieve little or nothing, or we can develop special knowledge in a limited sphere and accomplish wonders. Fortunately, horticulturists have given us the means to achieve the latter—and among the trees that make up the subject matter of this Handbook are some of the finest species in the plant world. In photographs they appear to have a certain monotony of form, yet as living specimens their varied textures and color hues make them outstanding when properly used in home landscaping. By all means let the pages that follow go to work for you today.

George S. Avery

The cover photograph of Kashmir cypress came from Sir George Taylor, Director of the Royal Botanic Gardens at Kew, England, just as this Handbook was going to press. This is the oldest confirmed specimen in cultivation; it grows in the Temperate House at Kew. Sir George reports having camped years ago under such a tree growing in the wild in Kashmir.

One man's favorites . . .

THE FIFTY FINEST CONIFERS

Henry Teuscher

MY CHOICE of the fifty finest conifers expresses a personal opinion which may not be shared by everybody. In addition, my selection disregards hardiness in an attempt to name the most beautiful species, regardless of whether they have so far shown themselves amenable to cultivation.

In order to supplement the ideal with the practical, a survey of authoritative opinion has been conducted throughout North America to establish which ten conifers are considered to be most desirable in each of the major regions of this large continent.

The results have been most gratifying, and I wish to use this opportunity to thank all those who have so kindly cooperated. The brief remarks made by the contributors on the various species and forms they have selected are very instructive and worthy of careful attention. Many of them shed new light on the possibilities of planting certain conifers under varying climatic conditions.

It is my sincere hope that the contrast between my idealistic selection of the fifty finest conifers, and the practical approach of the 26 regional lists (beginning on page 34) will stimulate further experimentation. There are still many regions, such as the Carolinas, the mountainous parts of the southern states, parts of the Sierra Nevada of California, and of the West Coast generally where conifers have never been tested systematically, and which might well offer suitable conditions for growing some of the finest conifers.

Abies amabilis, the cascade or red silver fir, is native to British Columbia and Alberta south to Oregon. In its native habitat it reaches a height of 200 feet or more, and it is perhaps the most beautiful of all the firs. The bark of mature trees is almost white or silvery gray, the branchlets gray with dense short hairs. The needles, closely set and 2 to 3 cm (1-1¼ inches) long, are shiny dark green above and have broad white bands below. This imposing and strikingly handsome tree is conical in outline and has shown itself quite hardy on the East Coast of North America as far north as Massachusetts. However, coming from a fairly humid climate, it definitely requires wind shelter on the East Coast.

Abies concolor, Colorado white fir, is native from Colorado to the mountains of New Mexico and into southern California. It attains a height of 100 to 120 feet. The spreading but usually upward curving needles are 4-6 cm (2-3 inches) long and more or less grayish green and are rounded, not notched at the tip. In spite of its Western origin, this is one of the most satisfactory firs in most parts of the United States, including the East Coast, and is hardy as far north as southern and western Canada. A particularly desirable form is 'Violacea', with conspicuously whitish-blue needles, and the same beautifully symmetrical growth habit as the type.

Abies homolepis, the Nikko fir, is native to the mountains of southern and central Japan, where it reaches a height of 90 to 100 feet. The 2- to 3-cm (1 to 1¼-inches) long needles, which are shiny dark green above and have pointed, though often shallowly incised tips, on the twig are clearly parted to both sides. From the somewhat similar *A. veitchii,* with which it is sometimes confused, it is most readily distinguishable by its smooth young branches. Those of *A. veitchii* are covered with dense short hairs. In addition, the needles of *A. veitchii* are not parted to both sides on the twig. *A. homolepis* is a handsome tree, regularly pyramidal in outline. It succeeds in many parts of the United States and is hardy in the North as far as southern Canada.

Abies nordmanniana, the Nordmann or Caucasian fir, is native to the Caucasus and mountains of Asia Minor. There it reaches a height of 150 feet but rarely more than

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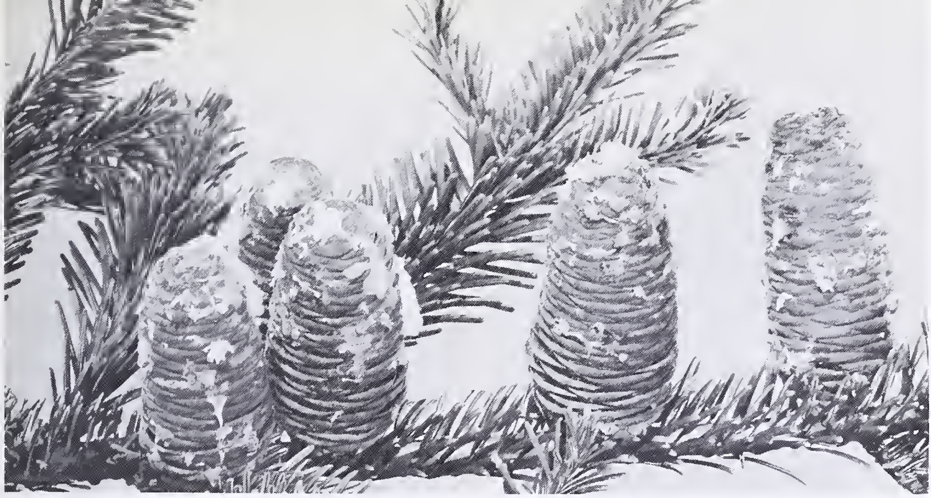
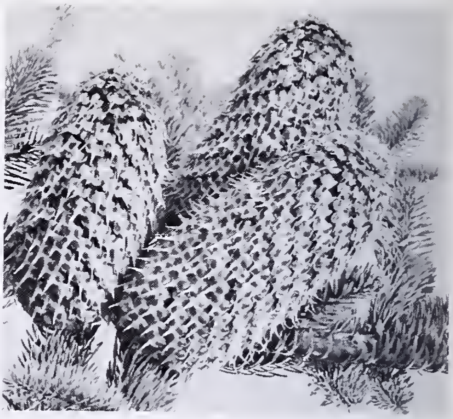


William Eng

The resin-covered, glaucous-purple cones of *Abies amabilis,* the cascade fir.

Abies concolor, the Colorado fir, in the Hunnewell Pinetum, Wellesley, Mass.

Abies homolepis umbellata, Nikko fir, at the Arnold Arboretum near Boston.

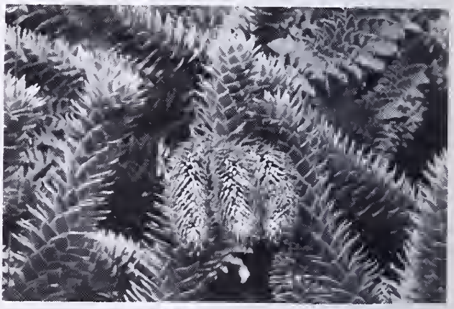


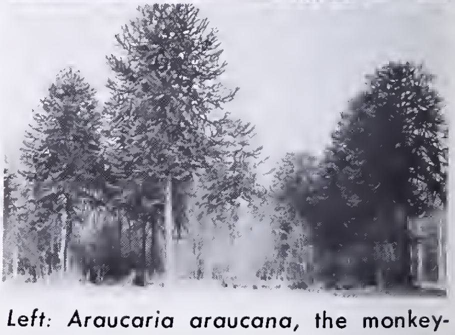
William Eng

◄

Abies procera, the noble fir, rises above rhododendrons at the University of Washington Arboretum, Seattle.
Above: The noble fir's beautiful cones, 6-7 inches long, are brown with green bracts.

Canada Dept. of Agriculture





Left: Araucaria araucana, the monkey-puzzle tree, growing in British Columbia. *Above top:* Branch detail of the monkey-puzzle tree. *Above:* Forest of monkey-puzzle trees growing in the Arboretum Tervuren, Belgium.

100 feet in cultivation. This is one of the few firs in which the winter buds are not covered with resin. Its branchlets are grayish and more or less densely hairy. The needles, 2 to 3.5 cm (1 to 1¼ inches) long, which cover the branchlets, are shiny dark green above and have whitish bands below. It is a very handsome and desirable fir, with closely set, spreading branches down to the ground. It is hardy as far north as parts of southern Canada, but it requires shelter from dry winds where such are to be feared.

Abies procera (A. nobilis), the noble fir, is native to the Pacific Northwest where it attains a height of over 200 feet, but usually not more than half that in cultivation. Its young branchlets are covered with short, brownish hairs. The needles, 2.5 to 3.5 cm (1¼ inches) long, are rounded or very slightly notched at the tip and bluish- or grayish-green in color. The noble fir is an exceedingly handsome tree and with wind shelter, which it definitely needs, it succeeds well in the eastern United States, though it usually is less vigorous there than in its western home. Under favorable conditions, it is hardy as far north as southern Massachusetts. In Canada it is reliably hardy only in southern British Columbia. Most outstanding are 'Argentea', and 'Glauca', two cultivars which have needles of a whitish-bluish cast.

Abies veitchii, the Veitch fir, is native to the mountains of central Japan and reaches a height of 75 to 100 feet. Its young branchlets are covered by short hairs. The densely set needles are 1 to 2.5 cm (½-inch) long, with truncate (straight cut) and notched tips, shiny dark green above and with conspicuous white bands below. This species is slower growing than *A. homolepis* and appears to be also somewhat more fastidious. Seedlings vary in hardiness and have to be carefully selected. Yet, this is a very handsome, desirable tree of broadly pyramidal habit. Under favorable conditions it is hardy as far north as parts of southern Canada. (See *A. homolepis* for the major differences between these two species.)

Araucaria heterophylla (A. excelsa), the Norfolk Island-pine, is native to Norfolk Island (due east of Australia) and there attains a height of 200 feet. In cultivation, it rarely reaches half this height. Because of its very regular habit of growth, with horizontally spreading whorled branches, it is one of the most beautiful and ornamental of all the conifers. *A. heterophylla* requires a temperate, close to frost-free climate, though it tolerates considerable summer heat if air humidity is reasonably high. It succeeds to perfection in parts of Florida, especially along the West Coast, below Tampa, where it has withstood 26°F. for three successive nights, without suffering damage. A 200-year-old tree of this species can be seen in the mountains of Jamaica (Campleton Gardens) and several excellent specimens of similar age, in the city of Cuenca, Ecuador, at 8,000 feet altitude. The mountainous parts of Puerto Rico and of the Hawaiian Islands offer promising localities for the growing of this species as well as of *A. bidwillii.* The hardiest species of this genus is *A. araucana,* the monkey-puzzle tree, which is being grown successfully in southern British Columbia.

Calocedrus (Libocedrus) decurrens, the Californian incense-cedar, is native to western North America from Oregon and Nevada to Lower California. Under favorable conditions it attains a height of over 120 feet and usually forms a densely branched, narrowly pyramidal or columnar tree, its cinnamon-red bark adding to its highly ornamental and very distinctive appearance. Its flattened branchlets are shiny green on both sides. Young plants sometimes resemble *Thuja plicata* but are readily distinguished from it by the odor —similar to that of *Juniperus sabina*—of the branchlets when rubbed between the fingers. As can be expected from its natural distribution, the incense-cedar is very satisfactory in cultivation on the West Coast of North America. It is frequently planted there—from San Francisco to Los Angeles. On the East Coast it has shown itself to be perfectly hardy at Philadelphia and Washington, D.C., and along the Connecticut, Rhode Island and Massachusetts coasts. Protection from strong winds is essential in northern areas.

Cedrus atlantica, the Atlas cedar, is native to North Africa (the Atlas Mountains of Algeria and Morocco), where it attains a height of somewhat over 120 feet. It is distinguished from the somewhat similar cedar of Lebanon (*C. libani*) by short-haired branchlets, shorter needles, and smaller cones. The cv. 'Glauca' is not only more beautiful than the species itself—its needles are silvery-blue—but also some-

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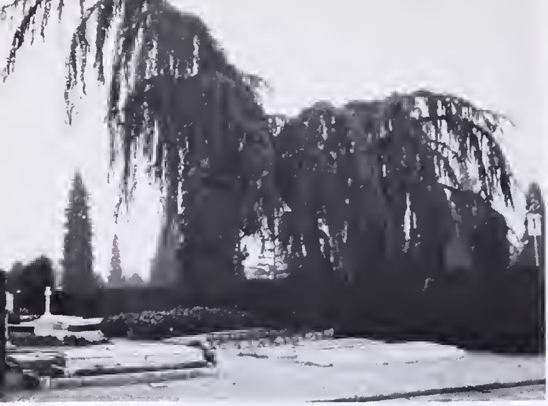
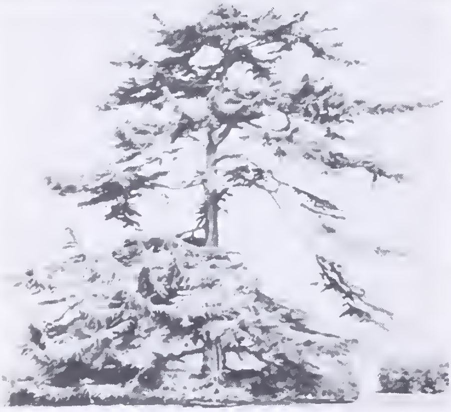
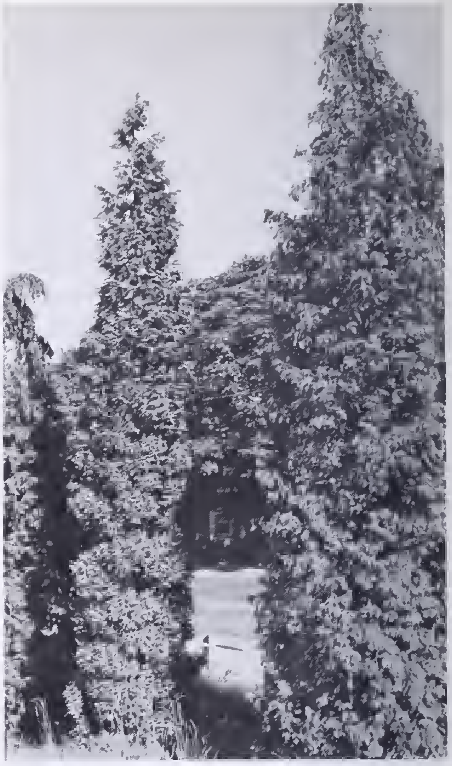




Top: *Cedrus atlantica* 'Glauca Pendula' in St. George's Cemetery, Geneva, Switzerland. *Above: Cedrus deodara* at Kew.



Whitie Marten

Variation in columnar form of *Chamaecyparis lawsoniana* shown in 40-45-foot specimens at University of Washington.

what hardier (as far north as New York in the eastern United States and to southern British Columbia on the West Coast). Very handsome also is cv. 'Glauca Pendula', with arching branches and pendulous branchlets. Its needles are gray-blue.

Cedrus deodora, the deodar cedar, is native to the northwestern Himalayas—Afghanistan and Baluchistan (northwestern Pakistan) at altitudes of 5,000 to 10,000 feet. In its native habitat it attains a height of 25-50 m (150 feet). Its somewhat pendulous young branchlets and leading shoot are often twice as long as those of the above mentioned two species. The deodar cedar is a very graceful and highly ornamental tree. It is frequently planted on the West Coast of North America, as far north as southern British Columbia. It is also safely hardy in many parts of the southern United States. On the East Coast it is being grown successfully as far north as Long Island and the southern New England coast. A remarkably hardy form was selected from a seedling lot at the Styler nursery at Concordville, Pennsylvania and named 'Kashmir'. It was the only survivor, in 1934, when the temperature suddenly dropped to 25° below zero. This cultivar has shown itself to be perfectly hardy as far north as the Arnold Arboretum near Boston, Massachusetts. It is easy to raise from cuttings.

Chamaecyparis lawsoniana, the Lawson false-cypress, is native to western North America (southwestern Oregon to northwestern California), and in its native habitat attains a height of well over 150 feet. It forms a dense, slender pyramid or column and retains its branches to the ground. The Lawson false-cypress is rather sensitive to dry winds. Where such are seasonal, it requires wind shelter. On the East Coast of North America it is hardy as far north as New York and, with wind shelter, some of its forms succeed as far as coastal Massachusetts. It was introduced into Europe in 1854 and is widely

William Eng

Chamaecyparis nootkatensis, Nootka false-cypress, at University of Washington Arboretum; 16 years old, 20 ft. tall.

'Pendula' form of Nootka false-cypress growing in the Arboretum's Japanese Garden. It is also about 20 feet tall.

planted there. Some 200 cultivars—mostly of European origin—are known to exist. Particularly handsome tall forms are: 'Erecta Viridis', with ascending branches which form a slender pyramid, fresh green even in winter; 'Triomf van Boskoop', with drooping branch-tips, more broadly conical in outline. The latter is the most widely known of the strong-growing, silvery-blue forms. On the West Coast *C. lawsoniana,* unfortunately, has in recent years been seriously threatened by Phytophthora root rot, which has caused the death of many valuable old specimens.

Chamaecyparis nootkatensis, the Nootka false-cypress, is also native to western North America (southwestern Alaska to Oregon), and attains a height there of 120 feet. It forms a graceful, densely branched, conical or pyramidal tree and is hardier than *C. lawsoniana.* It succeeds in eastern North America, with wind shelter, as far north as southern Canada. It is most readily distinguished from *C. lawsoniana* by its leaves, which are green on both sides, and lack the white or bluish markings on the underside of the leaves of *C. lawsoniana.* The most outstanding form of the Nootka false-cypress is 'Pendula', which has an upright main shoot and spreading branches, with long, pendulous branchlets. This form is generally considered to be one of the most beautiful of all the weeping conifers. In addition, it is somewhat hardier than the species itself. Very desirable also is 'Glauca', conspicuously bluish-green in color.

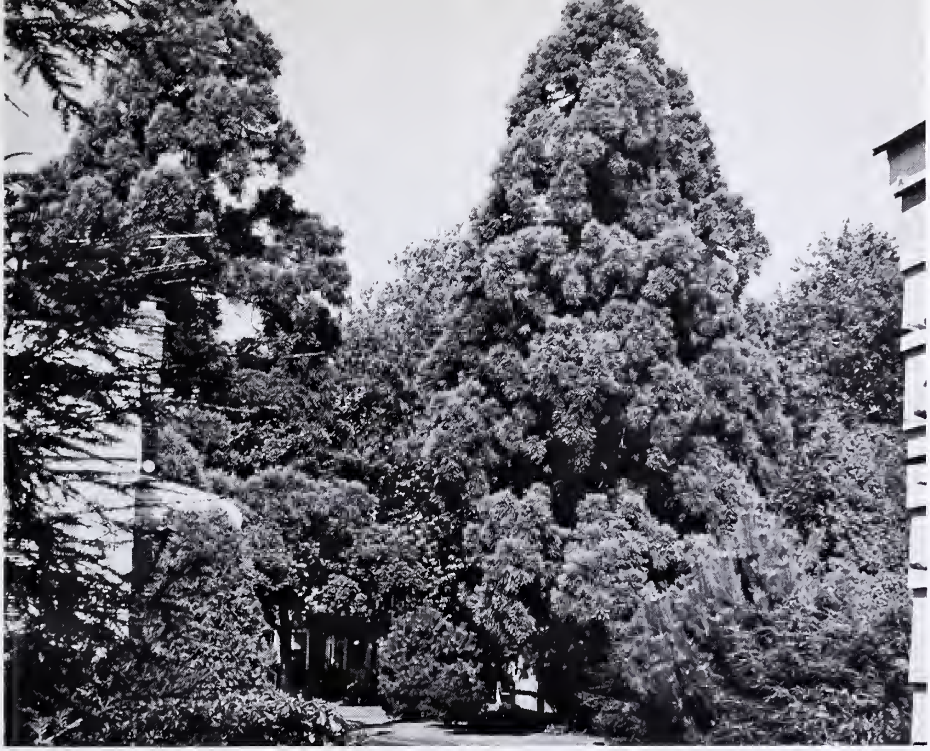
Chamaecyparis obtusa, the Hinoki false-cypress, is native to the mountains of southern Japan, at altitudes up to 3,000 feet. In its native habitat, it attains a height of over 120 feet. Under cultivation, it forms a conical, round-headed, dark green, handsome tree, but considerably under 20 feet in height. The horizontally arranged, somewhat curved branchlets give it a very distinctive appearance. In some of its forms it is hardy in North America as far north as southern Ontario, Canada. On the West Coast, it succeeds in parts of California and as far north as southern British Columbia. The Hinoki false-cypress was introduced into the West in 1861, and the numerous forms, especially the dwarfs, are more widely known and planted than the tree itself. One of its most generally appreciated varieties is 'Gracilis', which is of medium size, compactly pyramidal, and dark green. The tips of its branchlets are slightly pendulous.

Cryptomeria japonica, Japanese-cedar or cryptomeria, is native to China and Japan. It attains a height of over 120 feet and forms a broadly pyramidal, dark green, highly ornamental tree of very distinctive appearance. For best results, it requires a somewhat humid climate but, with wind shelter, for instance on a sheltered slope, it is usually hardy on the East Coast of North America as far north as New York City and Long Island. Some of its dwarf forms, which are more easily protected, succeed as far north as Massachusetts. On the West Coast it is hardy, in sheltered positions, as far north as southern British Columbia. The cryptomeria is an important conifer in Japan where it has long been planted in forests and gardens. Many dwarf forms—mostly with Japanese names—have been introduced.

Cupressocyparis leylandii, Leyland - hybrid cypress, is a hybrid between *Cupressus macrocarpa* (from Monterey, California) and *Chamaecyparis nootkatensis,* which originated in England in 1888. It forms a densely branched, slender pyramidal tree of very regular outline, eventually attaining a height of 50 feet or more. (In 1964, a specimen up to 100 feet was reported from Bicton, Devon, England, and several trees up to 80 feet exist at Kew Gardens. Thirty-year-old specimens over 60 feet seem to be average in England). In habit it resembles the columnar form of *Cupressus macrocarpa,* but its fanshaped branchlets are similar to those of *Chamaecyparis nootkatensis,* which it more nearly resembles. The combination of these characteristics, which is very pleasing, gives this dark green tree a highly ornamental appearance. It is much appreciated in northern California (the San Francisco region) for its wind resistance, and has been found hardy also in the State of Washington. Undoubtedly it succeeds also in the coastal parts of Oregon. On the East Coast of North America, it has shown itself to be hardy in the National Arboretum at Washington, D.C., where it receives a high rating. It is very satisfactory also on Long Island and in parts of the New York area, the latter region seeming to reprcsent its approximate northern limit. It deserves trial from there on southward, especially in the coastal regions of Virginia and the Carolinas.

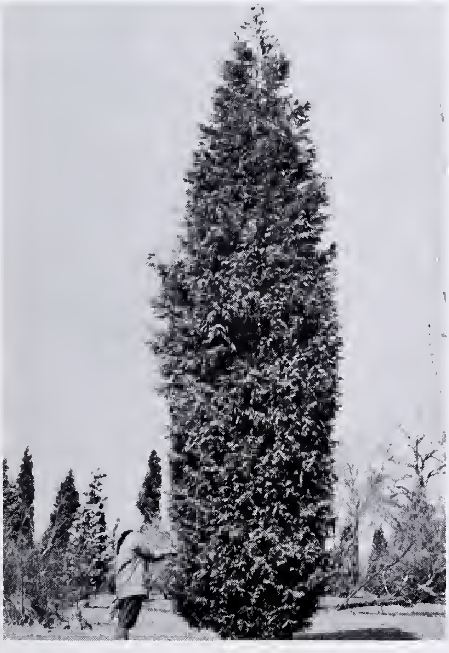
Cupressus arizonica, the Arizona cypress, is native to the mountains of Arizona, New Mexico and Mexico, where it attains a height of 70 or 75 feet. In eastern Arizona it still occurs in almost pure forests, several miles in extent. The conspicuously red bark is a particularly attractive feature of this broadly pyramidal, handsome tree. In some of its forms, the red color of the bark is retained through life, while in others the bark gradually turns gray, as the tree ages. The Arizona cypress is frequently planted in Texas, Louisiana, Florida, and parts of California, and has been reported as being hardy as far north as Washington, D.C. (National Arboretum). So far, Washington, D.C. seems to be its northern limit in eastern North America, but the species shows a distinct variability in hardiness, which deserves further investigation. One specific type which appears to be confined to the central Arizona mountains, mostly at altitudes of 4,000 to 5,000 feet, has even been separated as a species under the name *Cupressus glabra.* This appears to be hardier than others, is lower in stature (25 to 50 feet), and is said to retain the red bark coloring throughout life. Its foliage is more glaucous, and its cones are generally somewhat larger. It is very doubtful though, whether this actually is more than a variety of *C. arizonica.* At any rate, it would be highly desirable to seek out this type and to test it further for hardiness.

Cupressus cashmeriana, the Kashmir cypress, appears to be unknown in the wild state. Even the taxonomic standing of its name is in doubt, since it is suspected of being merely a form of *C. torulosa* to which it shows great affinity. However, it cannot be omitted from an enumeration of the fifty finest conifers, since it is undoubtedly the most beautiful of all the cypresses. It is a tree of narrowly pyramidal habit, with ascending branches and long—often several feet—flattened, pendulous, red-

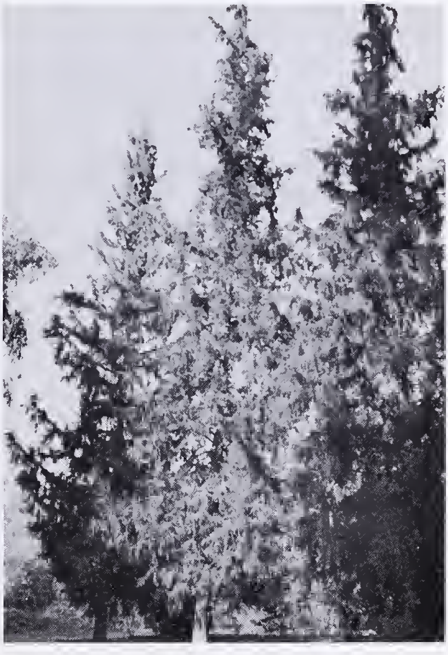


Marjorie J. Dietz

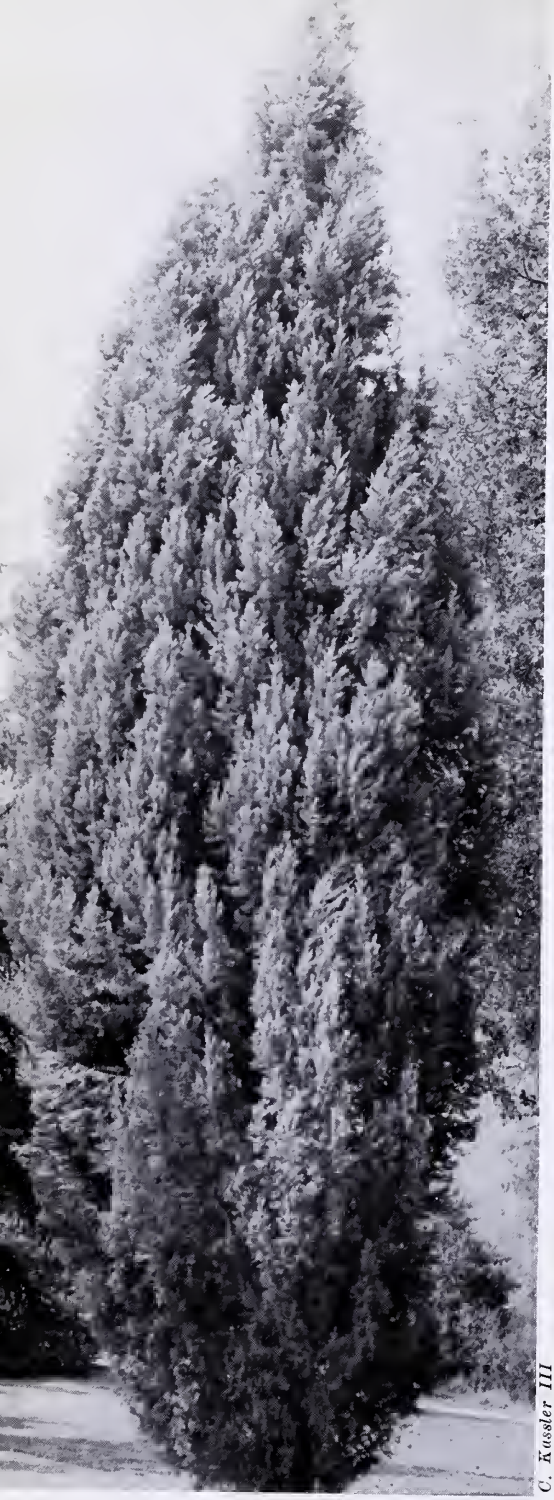
Two specimens of *Cryptomeria japonica* growing in East Hampton, Long Island, show the spreading pyramidal form and billowy foliage texture of this conifer.



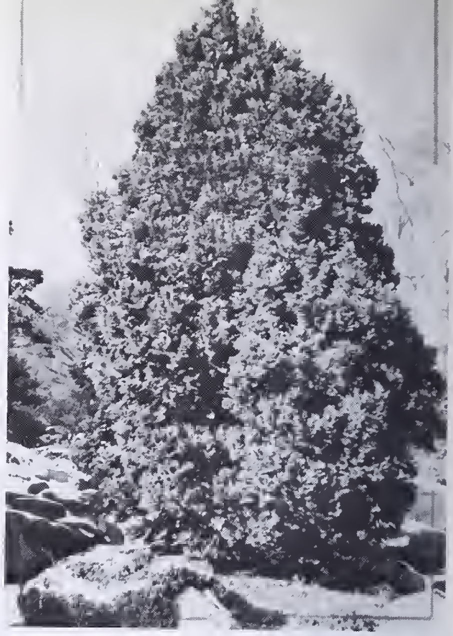
Cupressocyparis leylandii, Leyland-cypress, at Kalmthout Arboretum, Belgium.

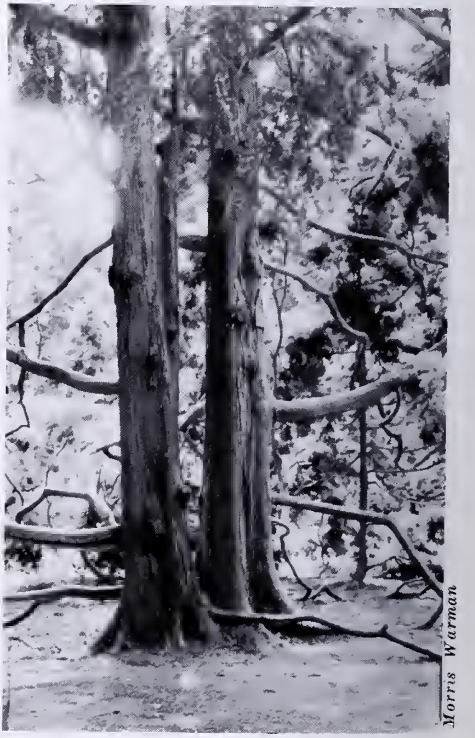


Cupressus arizonica, Arizona cypress, in Boyce Thompson Arboretum, Arizona.

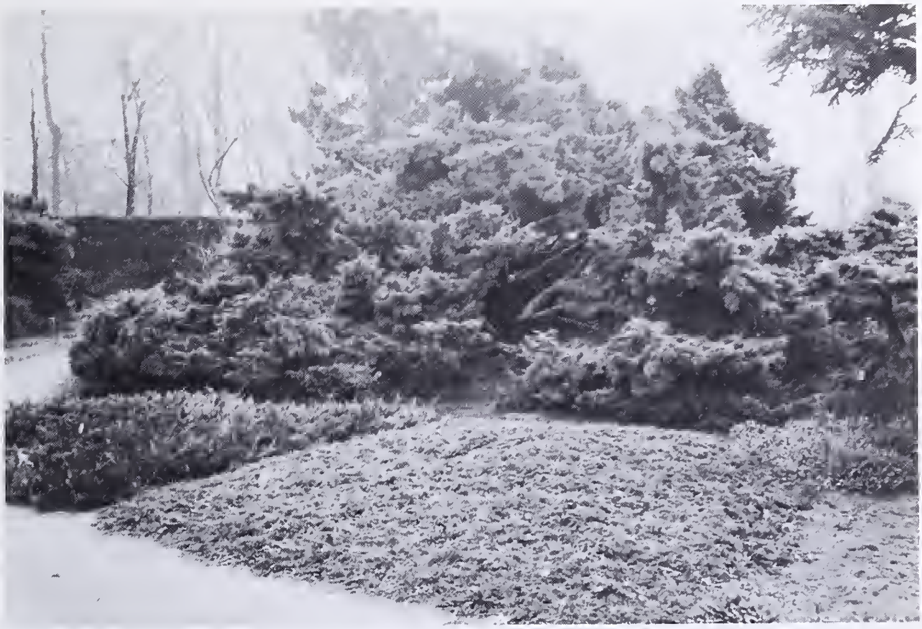

C. Kassler III

Cupressus sempervirens var. *sempervirens*, cypress of the Mediterranean.

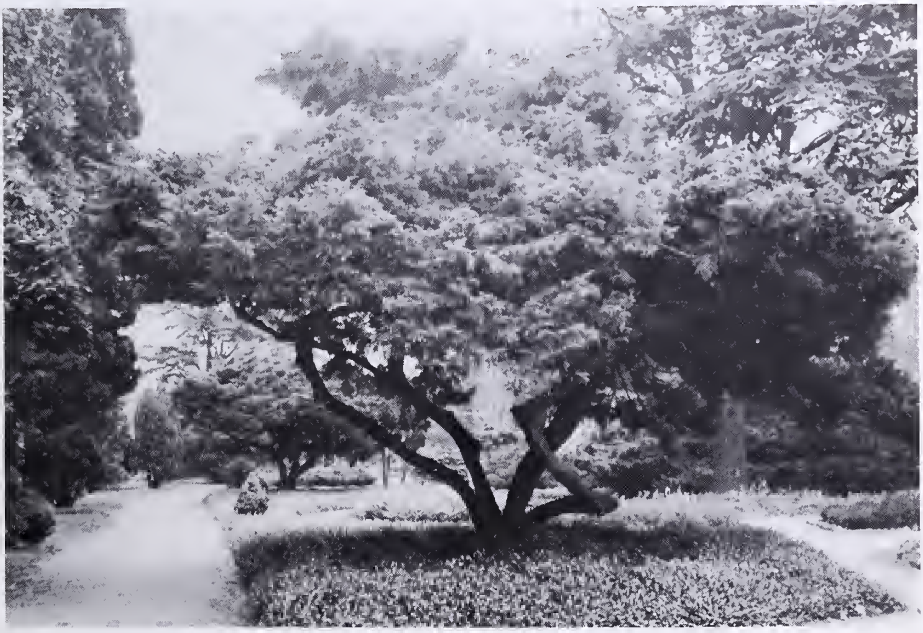

A 12-foot plant of *Chamaecyparis obtusa* 'Gracilis', Brooklyn Botanic Garden.


Morris Warman

Trunk and branch habit of *Chamaecyparis pisifera*, Cutting Arboretum, L.I.



The form of the always popular Chinese juniper, 'Pfitzeriana', is shown with two selections of another juniper *(Juniperus horizontalis)*, planted as ground covers.



Photographed by Frederick McGourty, Jr. in Holland's Arboretum Trompenberg

The same juniper (*J. chinensis* 'Pfitzeriana'), trained as a tree and about 10 feet tall. The ground cover plants beneath it are varieties of *Erica carnea* (heath).

dish-brown branchlets. The most famous tree of the Kashmir cypress was on the Isola Madre, an island in Lago Maggiore in northern Italy. It was 60 feet tall and of great beauty. Kew Gardens obtained cuttings from this tree and for some time was the only guardian of the species. The Kew specimen, which is grown in a temperate greenhouse, is still extant, and cuttings from it have been variously distributed. One tree, for instance, is known to be at the Edinburgh Botanical Garden. Introduction into North America seems to have been effected by the Planting Fields Arboretum at Oyster Bay, on the North Shore of Long Island. This specimen, which apparently was grown outdoors, does not seem to exist any more, but cuttings from it were rooted at Longwood Gardens, near Philadelphia, and an 18-foot specimen of this cypress may exist in one of Longwood Garden's temperate greenhouses. There may be other specimens elsewhere, of which we have no record, but so far this beautiful cypress has not found a home in the United States where it can grow outdoors. It can be expected to succeed under very much the same conditions as those found suitable for *Picea smithiana*, *i.e.*, parts of the coast of northern or central California, where frequent summer fog tempers the heat and where winter frost does not occur. Perhaps a suitable spot might be found for it also in the mountainous parts of Hawaii.

***Cupressus sempervirens* var. *sempervirens* (var. *stricta*),** the classical, columnar Italian cypress, probably originated in Italy. The species itself is native to southern Europe and western Asia. The Italian cypress attains a height of about 80 feet and is familiar to all visitors to Italy or Greece, where it has been frequently planted since ancient times, especially at cemeteries. The narrowly columnar, dark green trees are very conspicuous in the landscape and are highly ornamental in any proper setting. The Italian cypress is being grown very successfully in southern California, and should succeed also in other parts of the southern United States where similar climatic conditions prevail.

***Dacrydium cupressinum*,** the Rimu, is native to New Zealand, where it attains a height of about 100 feet. In cultivation, it is usually more or less shrubby, but under favorable conditions it develops into an outstandingly handsome and graceful tree. It is related to *Podocarpus*, though its leaves are scale-like. The branches are spreading or arching, while the long, slender branchlets are pendulous, giving a well-grown specimen a picturesque as well as distinctive and highly pleasing appearance. The Rimu has proved hardy at the Strybing Arboretum (Golden Gate Park, San Francisco), though it has developed there only into a tall shrub. It is being grown successfully in gardens on Oahu in the Hawaiian Islands.

***Juniperus chinensis*,** the Chinese juniper, is native to China, Mongolia, and Japan, where it attains a height of over 60 feet. It forms a tree of slender, pyramidal outline and is hardy in most parts of the United States and as far north as southern Canada. The Chinese juniper has been in cultivation in Europe for somewhat over 200 years, and many cultivars of it have been distinguished by names. The sexes of this species are on different plants, and one of the most desirable of tall columnar forms is probably the form 'Mas', a male form. It flowers freely in spring, and the numerous yellow flowers are conspicuous against the somewhat bluish-green foliage. Other choice, hardy cultivars of similar habit are 'Pyramidalis' and 'Obelisk'. Mention must be made also of the widely planted cv. 'Pfitzeriana', which develops several leading shoots and spreads picturesquely with ascending branches and nodding branchlets, rarely reaching a height of over 6 feet although taller specimens are known to exist in Europe. The slow-growing, golden-yellow form 'Pfitzeriana Aurea' is very handsome.

***Juniperus communis suecica*,** the Swedish juniper, is native to Scandinavia and sometimes occurs in pure stands in Sweden. It forms a slender, densely branched, columnar tree, attaining a height of 40 feet, the nodding tips of the branchlets being characteristic. Tall specimen plants almost resemble the Italian cypress, though the foliage is slightly bluish-green. This variety deserves to be singled out from the many other named forms of this species as a highly ornamental, tall type. In addition, it is hardier than other columnar forms of *J. communis*, succeeding in North America as far north as parts of southern Canada. Another desirable type of *J. communis* is cv. 'Stricta' (var *hibernica*) the Irish juniper, which also is nar-

Barbara Matthews

New Zealand's conifer, the Rimu (*Dacrydium cupressinum*), growing in a rain forest of tree ferns and other tropical plants. *Right:* Scale-like leaves of the Rimu as shown in a drawing from Lambert's *A Description of the Genus Pinus*, 1832.

Genereux

Juniperus virginiana, the red-cedar.

Swedish juniper (*J. communis suecica*).

Arnold Arboretum

Typical habit of *Juniperus scopulorum*.

Arnold Arboretum

Juniperus scopulorum 'Gray Gleam'.

rowly columnar in outline and densely branched. But it is more tender and much slower growing than *suecica*. The cultivar 'Depressa Aurea' is mat-forming and has golden-yellow branch tips. It is hardy in southern Canada. *Juniperus communis,* in all its forms, is very partial to a sandy, or at least well-drained, somewhat acid soil and becomes chlorotic in an alkaline soil. Like all junipers, it requires full exposure to the sun.

Juniperus scopulorum, the Western red-cedar or Rocky Mountain juniper, is native from Alberta to British Columbia and south through Oregon to Texas and Arizona. In its tall forms it attains a height of 35 feet or more. This species is closely related to *J. virginiana* and, though it is definitely distinct—ripening its larger fruits in the second year instead of in the first, and having only six instead of ten to twelve stamens in its male flowers—it has long been overlooked. It has come to public attention only during the last 30 or 40 years, when several outstanding bluish or silvery-blue, pyramidal forms of it, such as the cultivars 'Argentea', 'Gray Gleam', 'Chandler's Blue' and others, were introduced by nurserymen. As can be expected from the natural distribution of the species, the hardiness of the different forms varies, depending on their geographical origin. Some of them, though, such as 'Chandler's Blue', are hardy as far north as southern Canada.

Juniperus virginiana, the red-cedar, is native from Hudson Bay in Canada to Florida, Louisiana and Texas. In its tall forms it attains a height of 80 or 90 feet. The red-cedar has been in cultivation in Europe for over 300 years, and numerous horticultural forms have been distinguished. Like those of *J. scopulorum,* these cultivars differ in hardiness, depending on their geographical origin. Three of the most outstanding forms of tall, compact pyramidal or columnar habit are 'Burkii', which is conical in outline, bluish-green in color, and exceptionally hardy and vigorous; 'Canaertii', which is dark green, and particularly ornamental when it is covered with its freely-produced, bluish-white-waxy fruits (it has both sexes on the same plant); and 'Glauca', which has almost steel-blue foliage. The two first-named cultivars are hardy as far north as parts of central Canada. 'Glauca' is slightly more tender, but succeeds in southern Canada.

Keteleeria davidiana, which is related to the fir (*Abies*), is native to the mountains of mid-western China, where it attains a height of well over 100 feet. It forms a very handsome tree, its horizontally spreading, more or less whorled branches giving it the general appearance of a fir. It differs from *Abies* in the central keel, above as well as below, of the shiny green needles, and in the yellowish-gray color of the young branchlets. The scales of the upright cones do not drop off, as they do in *Abies,* but remain on the axis as in *Picea. Keteleeria* is certainly a very desirable conifer and is being successfully grown in the San Francisco region of California. The limits of its hardiness elsewhere cannot be established at the present time because, so far, it has not been tested sufficiently. Judging by its native distribution, *K. davidiana* can be expected to succeed in many of the mountainous parts of the southern United States, such as in those of the Carolinas. It appears to be much less sensitive to low atmospheric humidity than most firs, which renders it still more promising for planting in the above mentioned regions. Plants were distributed early in 1969 for testing to botanic gardens by the U.S.D.A. at Beltsville, Maryland, so more should soon be known about the hardiness of this species.

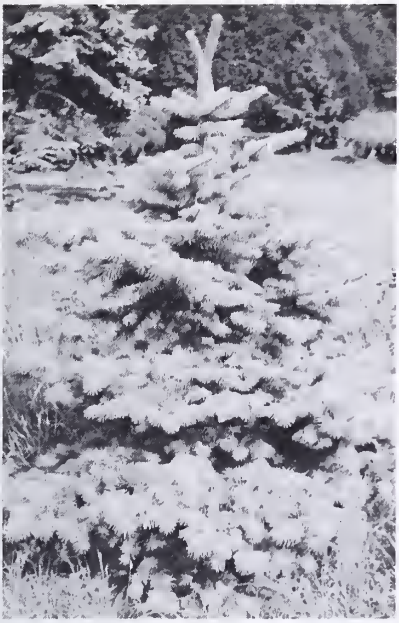
Metasequoia glyptostroboides, the dawn-redwood, is native to west-central China (province of Szechwan), where it attains a height of well over 100 feet. It had long been known from fossil remains found in various parts of the world, but was believed to be extinct until living trees were discovered in China in 1941. It is a deciduous tree, shedding its branchlets in the fall in the same manner as *Taxodium,* to which it is related, though it is much more handsome and faster growing as well. The leaves, about 8-15 mm (½ inch) long, color brightly in the fall. Its main taxonomic difference from *Taxodium* is in the flowers, the cones being suspended on long stalks. Another difference is that the dawn-redwood's branches are opposite, and in *Taxodium,* alternate. The dawn-redwood was introduced into cultivation in North America in 1947 and has shown itself to be hardy and highly satisfactory in most parts of the United States, from Louisiana in the South to Michigan in the North. With wind shelter it is hardy also in southern Canada.

(Continued)

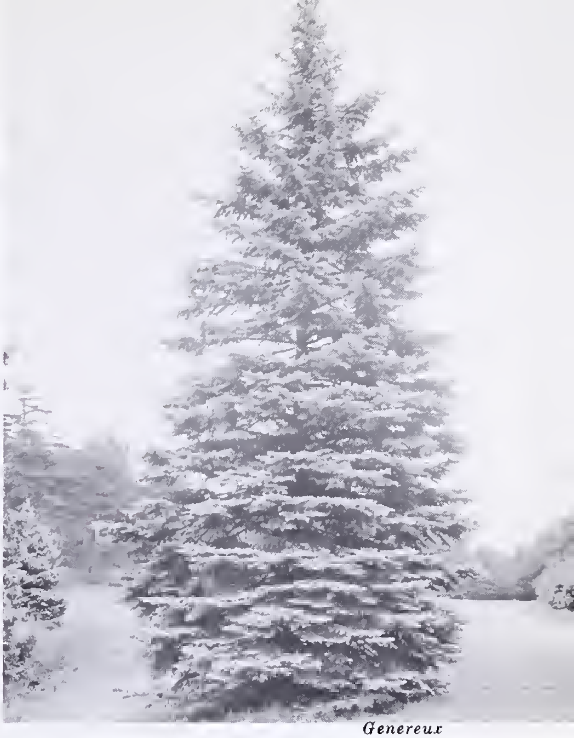
The dawn-redwood (*Metasequoia*) is flourishing as a street tree in Boskoop, the Netherlands (above); also in the N.Y. Botanical Garden (below). Both photographs taken in winter.

The dawn-redwood, which is deciduous, in summer foliage at Brooklyn Botanic Garden. This tree is about 20 years old.

Coning branch of *Picea sitchensis*, the Sitka spruce, as photographed on Washington's coast by B. O. Mulligan. The brown cones are 3-4 inches long.

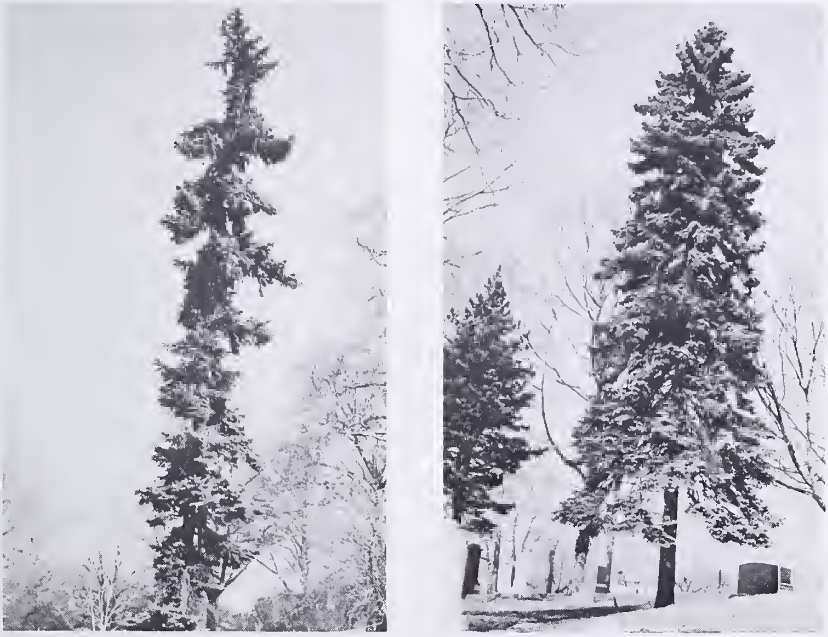


A young specimen of *Picea pungens* 'Kosteri' in the Arnold Arboretum.



Genereux

The typical form of a fairly young Colorado spruce, *P. pungens*.



Frederick McGourty, Jr.

Two examples of the variability of the Colorado spruce, *Picea pungens*.

Picea breweriana, Siskiyou spruce or Brewer's weeping spruce, is native to western North America from southern Oregon to northern California, and in its native habitat attains a height of somewhat over 120 feet. This is an outstandingly handsome spruce, with spreading branches, and very long, hanging, densely needled branchlets. The almost flat, radially spreading needles are about 2½ cm (1¼ inches) long, dark green on one side and with two white lines on the other. This beautiful tree is reasonably hardy but its requirements limit its usefulness as an ornamental. In its native mountains, it grows in rather dry, rocky soil, but the atmospheric humidity is high, due to frequent fog. This means that in less humid regions, the Siskiyou spruce definitely requires wind shelter. So far, it has not been very satisfactory in the eastern United States, though under favorable conditions it is hardy as far north as southern Massachusetts.

Picea omorika, the Serbian spruce, is native to a small area in southern Europe (along Yugoslavia's River Drina in limestone cliffs) and attains a height there of over 100 feet. It forms a slender, narrowly pyramidal to almost columnar tree, with rather short, spreading and upward arching branches and with densely needled, drooping, pubescent branchlets. The needles, 10-20 mm (½-¾ inch) long, are shiny dark green, with two white lines on one side. This graceful, distinctive, and rather fast-growing spruce readily keeps its branches to the ground, and is highly satisfactory wherever it finds suitable conditions. It has been in cultivation since about 1880 and is reliably hardy in North America as far north as southern Canada.

Picea orientalis, the Oriental spruce, is native to the Caucasus and Asia Minor, but is much hardier than its origin might suggest. In North America, it has been found hardy and highly satisfactory as far north as southern Ontario, Canada. In its native habitat it attains a height of 120 to 180 feet or more. In cultivation it is rather slow-growing, forming a densely branched, compact and handsome tree, with slightly pendulous branchlets. The latter are densely covered with short and appressed, glossy dark green needles, 6-8 mm (¼-½ inch) long. The Oriental spruce rates inclusion in the fifty finest conifers because it readily retains its lower branches and is conspicuous and graceful. It is widely appreciated in eastern North America from Philadelphia and Long Island northward. It should do well also in the Carolinas. Its cv. 'Aurea' has golden-bronze needles.

Picea pungens, the Colorado spruce, is native from Wyoming to Colorado, Utah, and New Mexico, attaining in its native habitat a height of 100 to 150 feet. Its branches and its densely needled branchlets spread more or less horizontally in very evenly spaced whorls. The stiff and prickly needles, 2-3 cm (¾-1¼ inches) long, are dark green or bluish green. The best of the tall, bluish forms is 'Glauca', which is available in the trade in several selected types, such as 'Moerheimii', 'Argentea', 'Kosteri'. The last is whitish-silvery-blue. The Colorado spruce is notable for its beauty, but at least at the Brooklyn Botanic Garden, has not lived up to its reputation of being less sensitive than other spruces to air pollution common to all large cities. This spruce is tolerant of slightly alkaline soil and water. It has been in cultivation since 1862 and is widely planted in the United States. It is hardy as far north as southern Canada.

Picea sitchensis, the Sitka spruce, is native to northwestern North America from Alaska to the mountains of northern California. In its native habitat it attains a height of 120 to 160 feet or more. Its branches spread more or less horizontally, forming a broadly pyramidal or conical crown. The stiff and prickly needles, 2½ cm (about ¾ inch) long, are almost flat, and shiny green on one side and silvery-white on the other. The contrasting colors of the needles are conspicuous and greatly enhance the beauty of this handsome tree. Unfortunately, the Sitka spruce, is not very satisfactory in general cultivation, and especially not in the eastern United States. It is adapted to a cool and humid climate and it suffers in dry, hot summers. Nor does it thrive in heavy soils, preferring one that is acid, moist and sandy. Outside of its natural range it definitely requires wind shelter but, where it succeeds, it is one of the most beautiful of all the spruces. It has become an important exotic conifer in the British Isles where it is now widely planted.

Picea smithiana (P. morinda), the West Himalayan spruce, is native to the Himalayas, from Bhutan (East of Nepal) to Afghanistan, at altitudes of 6,000 to 10,000 feet. In its native habitat, it attains a height of 150 feet. The spreading

Picea omorika in Kew Gardens. *Right: Picea breweriana* in Westbonbirt Arboretum. *Below:* Conifers at Bedgebury, England.

B. O. Mulligan

William Eng

Pinus armandii, Armand's pine, in the University of Washington Arboretum.

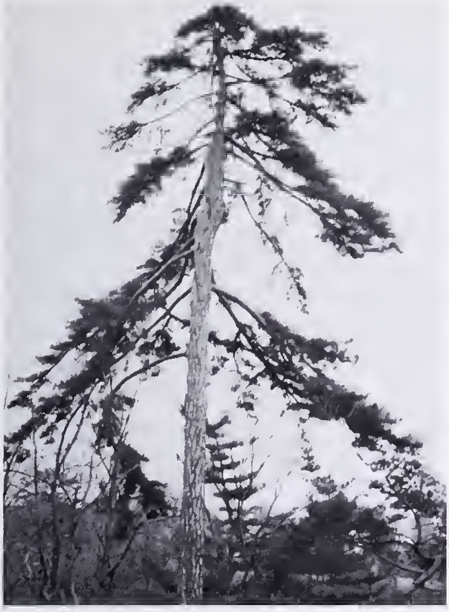
Genereux

Pinus cembra, the Swiss stone pine, is a favorite among slow-growing conifers.

branches have slender, drooping branchlets, which are densely covered with radially spreading, exceptionally long (4 to 5 cm or 1½ inches), dark green needles, giving this broadly pyramidal tree outstanding beauty. The hardiness of the Himalayan spruce should be rather similar to that of *Cedrus deodara*—with which it is frequently associated in nature—but it appears to be more sensitive to dry, hot summers, being most happy in a cool, moist atmosphere. It has proven hardy and highly satisfactory in the San Francisco region of California, and it can be expected to do equally well along the West Coast north to Oregon and Washington—wherever cool summer fog occurs. It was introduced into cultivation in 1818.

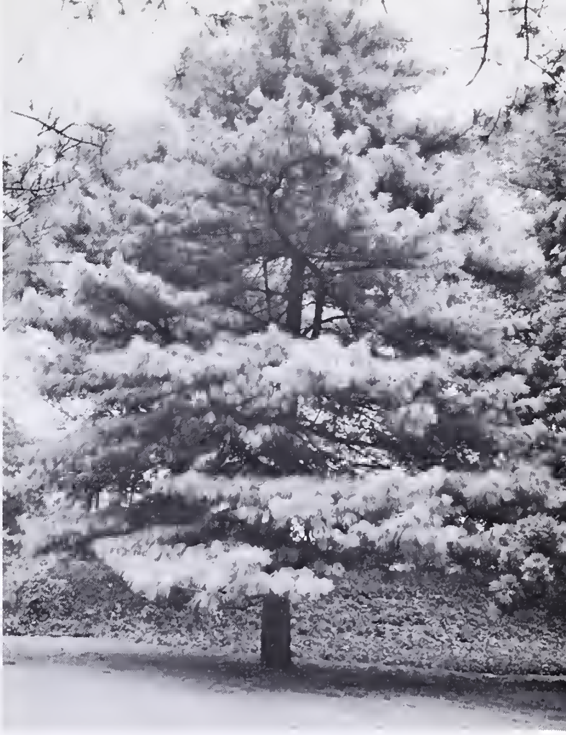
Pinus armandii, the Armand's pine, is native to central and western China and has been reported also from Taiwan and Korea. It attains a height of 60 feet or more, and its widely spreading branches give it a loose, picturesque appearance. The slender, long (10-15 cm or 4-6 inches) needles are light green. This very handsome pine has a certain resemblance to *P. wallichiana*, but differs conspicuously in the color of the needles—which also do not droop as much—as well as in the non-bloomy branchlets, and in its general habit of growth. The Armand pine had been in cultivation since 1895 and has shown itself hardy in many parts of the central United States. On the East Coast of North America it succeeds with wind shelter as far north as eastern Mass.

Pinus cembra, the Swiss stone pine, is native to the Alps of central Europe, as well as to northeastern Russia and northern Asia. Though rather slow-growing, it will attain a height of about 100 feet in its native habitat. In cultivation, it forms a densely branched, broadly columnar or narrowly pyramidal tree of very distinctive beauty. The young branchlets are covered with a brown felt, and the needles, (5-10 cm or 2-3 inches long), are dark green, with thin, white lines on both sides. *P. cembra,* which has been in cultivation in Europe for a very long time, requires a light acid soil, an absolutely airy position, with free air movement and full sun. It is hardy in North America as far north as southern Canada and, in its Siberian form, var. *sibirica*, even in central Canada.



Frederick McGourty, Jr.

Pinus nigra var. *nigra*, the Austrian pine in Brooklyn's Prospect Park.



Warman

Pinus wallichiana, the Himalayan pine, growing in the Brooklyn Botanic Garden.

***Pinus nigra* var. *nigra* (var. *austriaca*)**, the Austrian pine, is native to central Europe from Austria and Hungary to the Balkans (Yugoslavia and Rumania). It is a sturdy, vigorous-growing tree, attaining a height of somewhat over 100 feet, and its dark green, densely spaced, usually somewhat incurving needles are 8 to 10 cm (4 to 6 inches) long. It is reliably hardy throughout most of the central and northern United States, as well as in southern Canada, where it is frequently planted for ornament. It is somewhat coarse in appearance and lacks grace, but wherever climatic conditions prohibit the growing of more attractive pines, the Austrian pine is well worthy of a place. An outstanding attribute of it is that it is less fastidious in its soil requirements than most other pines, and will succeed even in fairly heavy clay soil, tolerating a pH slightly above normal. In addition, it appears to be resistant to air pollution when not excessive. It has been in cultivation in Europe for over 200 years.

***Pinus palustris*,** the long-leaf pine, is native to southeastern North America from Virginia to Florida and Louisiana, and is undoubtedly the most beautiful of all the southern regional pines. It attains a height of over 100 feet, and is frequently planted for ornament in the southern United States. It is probably hardy somewhat north of its natural range, at least up to Philadelphia. Its ascending branches form an oblong, open head, and the orange-brown bark adds to the attractive appearance of this handsome tree. The dark green needles, which are in clusters of three, are 20 to 45 cm (18 inches) long and form tufts at the ends of the branches. The branches are frequently brought into the cities for use in decorations.

***Pinus parviflora*,** the Japanese white pine, is native to the mountains of Japan, where it attains a height of 90 feet or more. Young trees are rather densely pyramidal in shape but, as they get older, irregularly spreading branches render them picturesque, giving them a very individual and most attractive appearance. The soft, green, usually twisted needles, conspicuously whitened in the center, are in clusters of five and are 2 to 8 cm (2 to 3 inches) long. The Japanese white pine is much appreciated in the eastern and midwestern United States, where it receives a high rating. It is hardy as far north as parts of southern Canada. Its cv. 'Glauca' is notable for its particularly pleasing, soft, bluish-colored needles which make this form blend more harmoniously with other conifers than do most blue conifers.

***Pinus wallichiana* (*P. griffithii, P. excelsa*),** the Himalayan pine, is native to the Himalayas, from Bhutan to Afghanistan, at altitudes to over 10,000 feet. In its native habitat it attains a height of somewhat over 150 feet. The Himalayan pine has been in cultivation in Europe since 1827 and has long been appreciated for its outstanding beauty. It is loosely and broadly pyramidal in outline, its spreading branches slightly ascending at the tips. The smooth branchlets are bloomy when young, and the 10-to-18-cm (5- to 8-inch) long, slender needles are grayish or slightly bluish-green, characteristically drooping. This graceful and highly ornamental pine is hardy in eastern North America as far north as eastern Massachusetts, though it requires wind shelter in the northern part of this range.

Along with *P. wallichiana* must be mentioned *P.* x *schwerinii* (*P. strobus* x *wallichiana*), which offers very promising possibilities, if outstandingly good forms are selected. So far, this has not been done systematically, though the Holden Arboretum at Mentor, Ohio, reports enthusiastically about one such good form. The hybrid of course does vary, producing inferior types as well as good ones. The best of the hybrid trees show not only hybrid vigour, growing much more strongly than either parent, but also have longer needles than *P. strobus*, are hardier than *P. wallichiana*, and are more resistant to pine-blister rust than *P. strobus*. Selected good forms can readily be propagated through grafting on seedlings of *P. strobus*.

***Podocarpus nagi*,** the Makino, is native to southern Japan, Taiwan, and China, and in its native habitat attains a height of about 90 feet. In cultivation it is rarely more than half this height. The flat, leathery leaves, which are two-ranked on the branchlets, are 4 to 7 cm (1½ to 2 inches) long and about 2 cm wide in the middle. They are shiny bluish-green on top, paler underneath and pointed at the tip. As in all members of the family *Taxaceae*, to which *Podocarpus* belongs, the flowers are usually dioecious (separated on different plants). The female flowers are solitary (not combined in cone-like receptacles), and the fruit resembles a drupe (a one-seeded berry). The Makino (*P. nagi*) is more handsome and graceful than the densely branched and narrow-leaved *P. macrophyllus*, which is widely planted in mild climates of the United States from Florida to California. *P. nagi*, which is more tender, is known to succeed in southern Louisiana and in parts of the Hawaiian Islands, but reports from elsewhere are lacking.

***Pseudolarix amabilis*,** the golden-larch, is native to the mountains of eastern China (Chekiang), where it grows at altitudes of 3,000 or 4,000 feet and attains a height of well over 100 feet. The whorled branches spread more or less horizontally or are arching, and the whorled needles—as many as 20 in one whorl and 7 to 8 cm (1 to 2 inches) long—give the tree a feathery appearance. The color of the needles is light green above and bluish-green underneath and changes to bright golden-yellow in autumn, which provides a very beautiful display. The golden-larch requires a light, more or less sandy, acid soil and will not tolerate lime. Where soil conditions are favorable, it is a highly recommendable, ornamental tree, which being deciduous, is much more resistant to air pollution than most other conifers. However, it does need a good deal of space and is not suitable for a small property. It is hardy in eastern North America as far north as Massachusetts and on the West Coast to southern British Columbia.

***Pseudotsuga menziesii*,** the Douglas-fir, is native to western North America from British Columbia to California, Montana, Colorado, western Texas and New Mexico. In its native habitat it reaches a height of over 250 feet and is a valuable timber tree. The soft, slender needles, which immediately distinguish it from any spruce or fir, are 2 to 3 cm (1 to 1¼ inches) long and are either fresh- or grayish-green or more or less bluish. The pendent, long cones 5 to 10 cm (3 to 4 inches) are distinguished by conspicuous, 3-lobed bracts which extend beyond the cone scales. The most valuable type of the Douglas-fir for horticultural purposes is its Rocky-Mountain form, var. *glauca*, which is slower growing, more compact in habit, and has slightly ascending young

A grove of *Pseudotsuga menziesii*, Douglas-fir, as it grows in the wild.

Pseudolarix amabilis, the golden-larch, shows its winter outline in Brooklyn.

Everett B. Clark

Podocarpus nagi, the Makino, is a suitable evergreen for mild climates.

Arnold Arboretum

This specimen of the golden-larch is in Cutting Arboretum, Long Island.

Campus Studios

Sequoiadendron giganteum, "big tree," in Seattle's Leschi Park, dwarfs observer.

branchlets. Its needles usually are more or less bluish-green. Its greatest asset is that it is hardier than the taller coastal form, being dependably hardy on the East Coast of North America as far north as southern Canada. This is a very handsome, densely branched tree of graceful pyramidal habit, which can be most highly recommended. It does prefer a neutral or slightly acid soil.

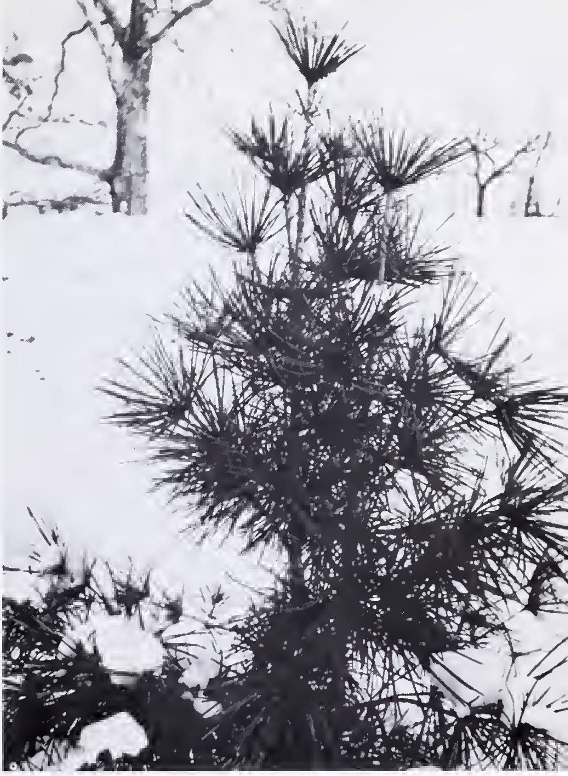
Sciadopitys verticillata, the umbrella-pine, is native to the mountains of central Japan and attains in its native habitat a height of about 120 feet. It has been in cultivation in Europe since 1861. The rather short, whorled, horizontally spreading branches give young trees an almost columnar outline; later a more or less pyramidal crown develops. The whorled, rather thick and stiff needles are 8 to 15 cm (3 to 6 inches) long and glossy, dark green above and with two white bands underneath. The whorls, which contain up to 30 or even more needles each, spread umbrella-like (the Greek word *skias,* from which the botanical name is derived, actually means "umbrella"). L. H. Bailey terms this tree "one of the handsomest and most distinctive conifers," which is most appropriate. The umbrella-pine is relatively slow-growing, prefers a fairly rich, humus soil, which must not dry out. On the East Coast of North America, it is hardy as far north as Massachusetts; on the West Coast, to British Columbia.

Sequoiadendron giganteum (Sequoia gigantea), "the big tree" or giant-sequoia, is native to the Sierra Nevada of eastern California, where it attains a height of over 300 feet. It forms a pyramidal, softly bluish-green, very handsome tree, which, under favorable conditions, readily retains its branches to the ground for at least fifty years of its life. Later, the lower branches are shed, but the giant-sequoia still remains an imposing tree. In the San Francisco region of California it is much appreciated for ornamental planting and is preferred to the coastal redwood (*Sequoia sempervirens*), though the latter is native in the near vicinity. Southern British Columbia also prefers the "big tree," as the coastal redwood, strangely enough, is not satisfactory there. On the East Coast, *Sequoia sempervirens* does extremely well in southeastern Virginia, where it is much planted, while *Sequoiadendron* does not give satisfactory results. However, there are specimens of

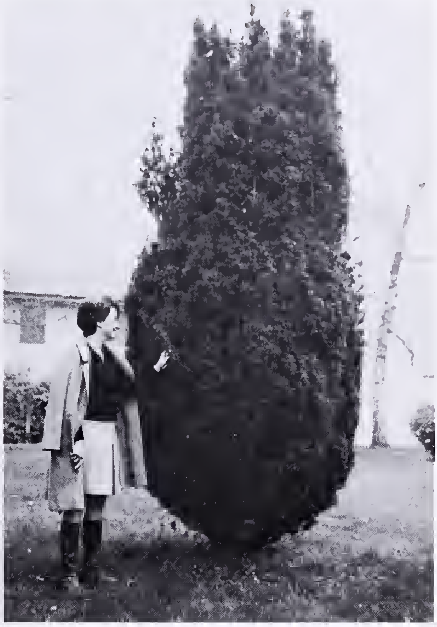
Sequoiadendron scattered through the Northeast. The oldest tree in the Northeast exists at the Tyler Arboretum, Lima, near Philadelphia. Others are found on Long Island and as far north as the Arnold Arboretum near Boston.

Taxus baccata, the English or common yew, is native to Europe, North Africa and western Asia. It is slow-growing but very long-lived, and will reach a height of 60 feet or more. The most readily recognizable differences between this species and the rather similar *T. cuspidata* are found in the winter buds. In *T. baccata* they have rounded scales which are not keeled, while the bud scales of *T. cuspidata* are pointed and keeled. The English yew has been in cultivation in Europe since ancient times, and numerous garden forms have been distinguished and named. One of its most desirable tall forms is undoubtedly the Irish yew (*T. baccata* 'Fastigiata'), which has ascending branches and forms a dense, slender column. It has been known to gardeners for years as var. *stricta.* Unfortunately, it is somewhat tender and does not seem to have been found fully satisfactory anywhere in North America. Much appreciated and widely planted is 'Repandens', which is low and spreading, fruits freely, and is hardier than other forms.

Taxus cuspidata, the Japanese yew, is native to Japan, Korea, and Manchuria and attains about the same height as *T. baccata.* (The difference in the bud scales of the two species has been explained above.) The short stalk of the rather dull green needles of *T. cuspidata* is usually yellowish, not greenish, as in *T. baccata,* which has more glossy leaves. Because of its greater hardiness, which extends as far north as southern Canada, the Japanese yew is much more frequently planted in North America than the English yew, and many garden forms of it have been distinguished by name. The original tree-like type, generally raised from seeds, is frequently distinguished as the form *capitata,* and was introduced into Western cultivation in 1855. It is a very desirable and ornamental dark green conifer, which can as readily be trained into tall, dense hedges as is *T. baccata* in England. The var. *nana,* which is medium-size, densely branched, and shrubby—never developing into a tree—is a good botanical variety (called *Kyaraboku* in Japan). It occurs in pure stands on the summit of Mt. Daisen



The distinctive silhouette of *Sciadopitys verticillata,* the umbrella-pine.



Taxus baccata 'Fastigiata' (Irish yew), in Jardin de Meyrin, Geneva.

An aged specimen of *Taxus baccata*, the common yew, growing in Brooklyn's Green-Wood Cemetery.

Taxus cuspidata var. *capitata*, the Japanese yew, in Brooklyn Botanic Garden.

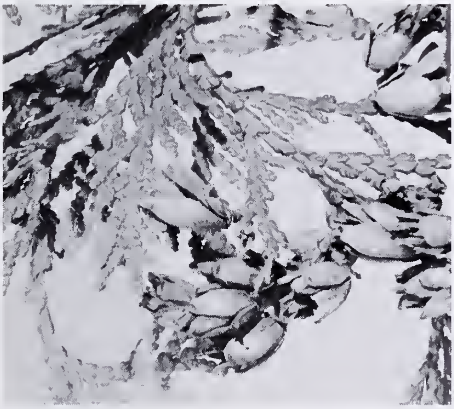
England's Pinetum

ONE of the world's great conifer collections is at England's National Pinetum, near Flimwell, Kent. The Pinetum, often called Bedgebury (after the forest it occupies), was begun in 1925 as a joint project of the British Forestry Commission, which wanted to determine the best timber trees for English conditions, and the Royal Botanic Gardens, which had been disturbed by air pollution effects on conifers at Kew Gardens near London.

Despite rather poor soil—an undersurface of hardpan—and a wretched micro-climate (in some years frosts have occurred every month at Bedgebury), the Pinetum contains a wide range of plants that are content with the environment. Many trees of America's West Coast thrive there, as do some from Europe and the Orient. Rare conifers from the Southern Hemisphere are also represented, including species of *Athrotaxis, Dacrydium, Fitzroya*, and *Saxegothaea*. Visitors should plan to spend the better part of a day at the Arboretum. A good country inn is nearby in the town of Hawkhurst, about a two-hour drive from London's Heathrow Airport.

—Frederick McGourty, Jr.

Thuja occidentalis, American arbor-vitae, in New York Botanical Garden.



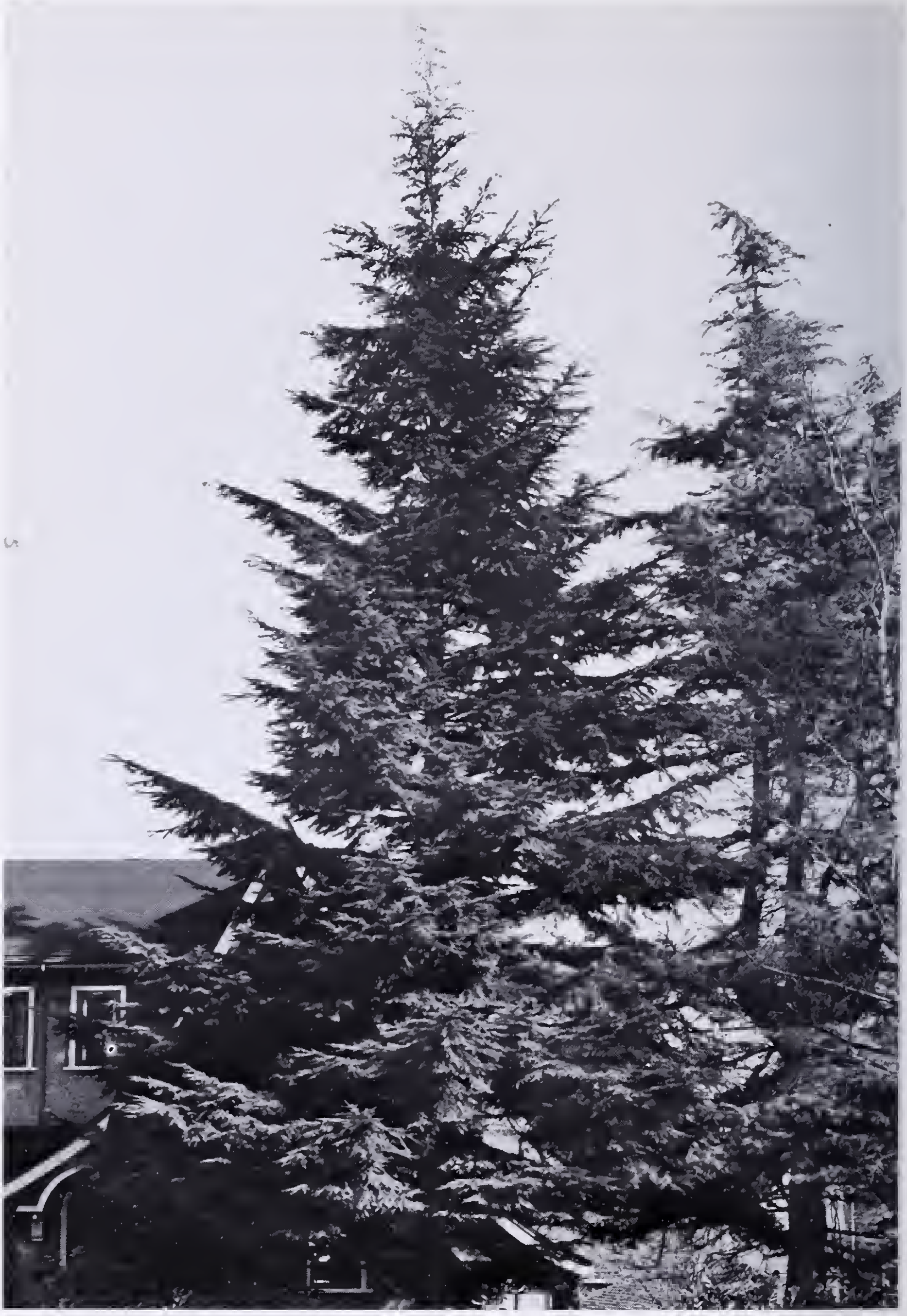
Roche

Scale-like needles and cones of American arbor-vitae (*T. occidentalis*).

►

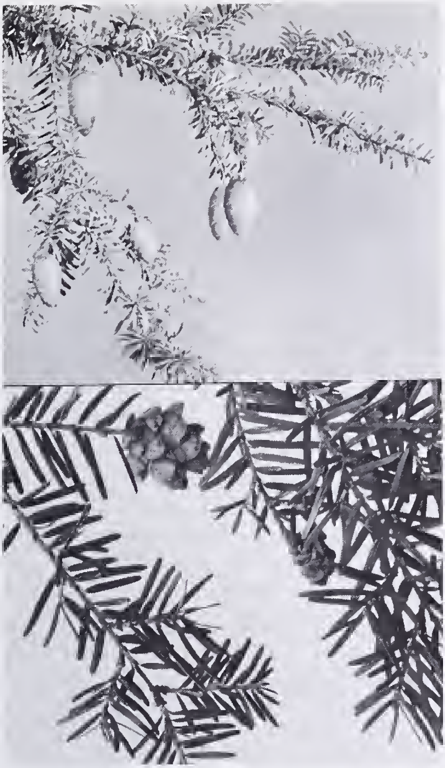
Thuja plicata, the giant arbor-vitae, 55 feet tall, growing in the University of Washington Arboretum, Seattle.

William Eng



Canada Dept. of Agriculture

Tsuga heterophylla, the western hemlock, is a beautiful evergreen for cool, moist climates. It is not generally satisfactory for the Northeast.



William Eng

Canada Dept. of Agriculture

Above top: Coning branch of *Tsuga diversifolia*, Japanese hemlock. Above: Needles of the western hemlock.

Warman

The Japanese hemlock *(Tsuga diversifolia)* at Brooklyn Botanic Garden.

(on southern Honshu), where the tree-like type is absent and where the var. *nana* is under government protection. Cv. 'Densa' is dwarf and very compact. It frequently occurs in cultivation in various types, when *T. cuspidata* is raised from seeds. It is a true cultivar, supremely suitable for dense, low hedges.

Thuja occidentalis, the American arbor-vitae, is native to eastern North America from Nova Scotia west to Manitoba and south to North Carolina, Tennessee, and Illinois. The most readily observable taxonomic differences between the genus *Thuja* and those other genera which resemble it in appearance, such as *Chamaecyparis* and *Calocedrus,* are found in the shape of the cones and the number and shape of the cone scales. The conspicuous glands on the scale-like leaves of *T. occidentalis* are another helpful distinguishing characteristic. The American arbor-vitae has been in cultivation in Europe for over 400 years, and numerous garden forms of it have been described and named. Its most desirable tall form is probably 'Columna', which originated in Germany in 1904. It develops into a very regular, slender column, with glossy, dark green foliage, and is very hardy. As is evident from the natural distribution of this species, it is hardy in North America as far north as central Canada. The various garden forms of *T. occidentalis* can be trained into tall, medium-size or tall hedges.

Thuja orientalis, the Oriental or Chinese arbor-vitae, is native to northern and western China as well as to Korea, where it attains a height of about 60 feet. It is handsome and ornamental and broadly pyramidal, distinguished by its flat branchlets which spread in vertical planes. Dwarf forms, such as the much favored cv. 'Sieboldii', which is bright

(Continued)

green, are more commonly grown in gardens than the tree itself, in part perhaps because they can be more readily protected in winter. *T. orientalis* is distinctly more tender than *T. occidentalis* and on the East Coast of North America, the species itself is not reliably hardy much farther north than New York City. It is frequently planted in Florida, especially along the Gulf Coast, as well as elsewhere in the Southern States and in parts of California. It has long been in cultivation in Japan and was introduced into Western cultivation in the early 1700s.

Thuja plicata (T. gigantea), the giant arborvitae, is native to western North America from Alaska to northern California and Montana, where it attains a height of about 200 feet. In cultivation it rarely reaches more than half this height, though it has been grown for more than 100 years. The graceful appearance of this very handsome, pyramidal tree is enhanced by the pendulous tips of its branches. The closely set branchlets are fan-shaped and have glossy, bright green, scale-like leaves. In the northern part of the West Coast of North America, as far north as British Columbia, the giant arbor-vitae is a highly appreciated ornamental tree. On the East Coast it has shown itself to be sensitive to low atmospheric humidity, though plants raised from seeds—collected in the northern part of its natural range—have proved hardy and highly satisfactory as far north as southern Ontario, Canada. Its best tall, columnar garden form is probably the cultivar 'Excelsa'.

Tsuga caroliniana, the Carolina hemlock, is native to eastern North America from the mountains of southwestern Virginia to Georgia, where it attains a height of 70 to 80 feet. It is rated as superior in beauty to the well-beloved *T. canadensis,* because it is more compact in its habit of growth and more handsome in general appearance. Its needles are slightly broader than those of *T. canadensis* and are glossy dark green above, with white bands underneath. The most readily observable taxonomic difference between these two species is that the margins of the needles of *T. caroliniana* are smooth, while those of *T. canadensis* are finely saw-toothed. The Carolina hemlock is hardy as far north as Massachusetts.

Tsuga diversifolia, the Japanese hemlock, is native to central Japan where it attains a height of 75 to 90 feet. It forms a very graceful, broadly pyramidal or conical tree. The young branches are rather conspicuously reddish-brown in color and very short and thinly pubescent. The closely set, wide 2.5 mm. (¼-½ inch) needles are glossy dark green above, with thin white lines underneath, and are notched at the tip. The Japanese hemlock has the same kind of smooth-margined needles as the Carolina hemlock, which is remarkable because this characteristic is typical for all the Asiatic species of this genus, while *T. caroliniana* is the only American species which shares it. *T. diversifolia* is hardy and highly satisfactory in cultivation in eastern North America as far north as Massachusetts. It was introduced into Western horticulture in 1861.

Tsuga heterophylla, the western hemlock, is native to western North America from southern Alaska to Idaho and California, where it attains a height of 200 feet or more. In cultivation it is a very graceful, pyramidal tree, with slightly pendulous branches and a whip-like leading shoot. Its young branches are covered with rather long, pale hairs. The needles are 6 to 18 mm (¼ to ¾ inch) long and glossy dark green. *T. heterophylla* is definitely far superior in beauty to *T. canadensis*—another reason for omitting the widely planted common hemlock from this list of the fifty finest conifers. In the northern part of the West Coast of North America from northern California to British Columbia, the western hemlock is highly appreciated and is freely used in ornamental plantings. On the East Coast, it has not been successful. It has adapted to a cool and humid atmosphere and does not tolerate dry, hot summers. ◆

THE DEODAR CEDAR

Two forms are being tested for hardiness

Alfred J. Fordham

THE DEODAR, Indian or Himalayan cedar (*Cedrus deodara*) is perhaps the most striking of true cedars, but it has been considered the least hardy of the genus. Through the years, deodar cedars have been tested repeatedly for hardiness at Arnold Arboretum (near Boston), but have always failed to survive, lacking the stamina to survive the cold winters.

In 1961 a grafted plant of a cultivar named *C. deodara* 'Kashmir' was given to the Arboretum, and in 1963 one called 'Kingsville' was donated. Each was planted in an exposed location, and each has since shown exceptional hardiness. These clones provide excellent examples of the unseen differences that can be present in individual plants. In nursery rows they would appear similar to other deodar cedars, yet they had an invisible genetic difference—the ability to withstand low temperatures. The winter of 1967-68 proved severe in the Arboretum nursery. Most plants of border-line hardiness were killed outright, while numerous others were severely damaged. However, both 'Kashmir' and 'Kingsville' showed some slight needle browning at the branch tips, but no damage to their buds or wood.

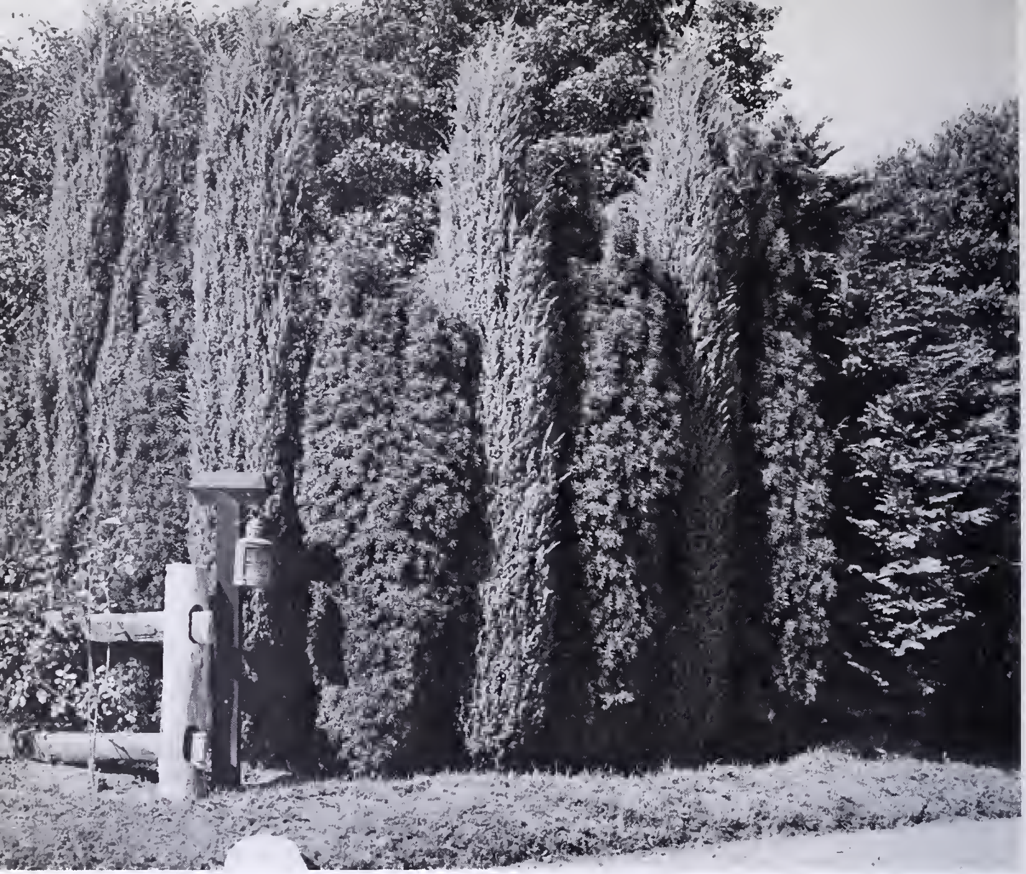
J. Franklin Styer

Original plant of 'Kashmir' cedar.

Cedar 'Kashmir' originated in the nursery of Dr. J. Franklin Styer, Concordville, Pennsylvania. Dr. Styer reports: "This is the only plant of 200 set in nursery rows in 1930 which survived the winter of 1933-34, when temperatures dropped suddenly to 25 degrees below zero. Standing alone, it also survived the similar winter of 1935-36. The only winter injury we have experienced with grafted trees has been on branches immediately above snow, and this has only occurred once, causing one lot to be bare of branches 2 feet up on the southwest side."

'Kingsville', which originated at Kingsville Nurseries, Kingsville, Maryland, has a similar history. Henry K. Hohman of Kingsville Nurseries says: "My cold-resistant specimen tree is now about 60 feet tall. It was the lone survivor from among a large crop of 7-foot trees after the extremely cold weather that hit Kingsville in the early thirties."

Both 'Kashmir' and 'Kingsville' are similar in character. Each is a strikingly beautiful, fast-growing tree with silvery blue-green nodding branch tips. They show promise of being fine additions to ornamental trees grown in climates similar to Boston's. Each tree is now approaching 12 feet in height and staminate conelets have appeared. We look forward to the time when pistillate conelets develop and seed production begins. Seedlings can then be screened for further signs of hardiness for here as well as even more severe climates. ◆



Marjorie J. Dietz

There are forms of juniper *(Juniperus)* and yew *(Taxus)* for nearly every climate. The entrance grouping above is composed of hardy columnar forms of both.

The Norfolk Island-pine *(Araucaria heterophylla)* is a conifer for southern regions. In the North, it grows as a house plant.

Everett Clark

Authorities from the North, South, Midwest, West, and West Coast select

THE 10 MOST SATISFACTORY CONIFERS FOR EVERY REGION

10 conifers for southeastern (Montreal region) Canada

Juniperus chinensis (Chinese Juniper)—The tall cultivars 'Pyramidalis' and 'Obelisk' and the shrubby 'Pfitzeriana' are particularly satisactory.

Juniperus scopulorum (Western Red-cedar)—The tall cultivar 'Chandler's Blue', which colors steel-blue in fall, is one of the hardiest with us.

Juniperus virginiana (Red-cedar)—The best tall variety with us is the cv. 'Burkii', which has bluish foliage and is perfectly hardy. Very good also is cv. 'Canaertii' which fruits freely.

Larix decidua (European Larch)—Very hardy and handsome. Preferable by far to the American larch.

Picea omorika (Serbian Spruce)—A very handsome, dark green, columnar tree. Perfectly hardy.

Picea pungens (Colorado Spruce)—We prefer the green-leaved type. Tolerates neutral and fairly heavy soil. Perfectly hardy. The slow-growing, densely branched *P. pungens* 'Montgomery' is also very satisfactory with us.

Pinus nigra var. nigra (Austrian Pine)—With us the most dependable pine for city park planting.

Pseudotsuga menziesii (Douglas-fir)—The bluish-green Rocky-Mountain form is perfectly hardy and highly satisfactory with us when planted in a soil with pH below neutral.

Taxus cuspidata (Japanese Yew)— Perfectly hardy with us. The slow-growing cv. 'Densa' is used for low hedges but requires protection against snow-breakage in winter.

Thuja occidentalis (American Arbor-vitae)—Much used for tall hedges. The most desirable variety with us is the strong-growing, dark green cv. 'Columna'.

—*Henry Teuscher*

10 conifers for eastern (Boston area) Massachusetts

Abies concolor (White Fir)—Excellent for its color, its vigor of growth and its ability to withstand average urban conditions.

Chamaecyparis obtusa (Hinoki-cypress)—Especially cv. 'Gracilis' but also other varieties of this handsome species are valued for their dark green foliage (yellow in cv. 'Crippsii') and for their dense habit.

Juniperus virginiana (Red-cedar)—A sturdy native, readily available in several forms. The pyramidal types are valued in limited space.

Pinus bungeana (Lace-bark Pine)—Deserves to be more frequently planted because of its dark foliage and the attractive bark of trunk and older branches. An excellent specimen when allowed to form several trunks.

Pinus strobus (White Pine)—Readily available in several excellent forms. Easily adapts to many conditions. Can be sheared if desired.

Pseudolarix amabilis (Golden-larch)—Deserves highest recommendation. Tree with wide-spreading branches and lacy foliage. Develops into a beautiful specimen when given enough space. Unsuitable for small gardens.

Pseudotsuga menziesii (Douglas-fir)—The hardy type from the eastern Rockies develops here into a graceful, dark green, pyramidal tree.

Sciadopitys verticillata (Umbrella-pine)—Its dense, pyramidal habit and the dark green foliage make this one of the very best conifers for a specimen tree in our area.

Taxus cuspidata (Japanese Yew)—Its many varieties and hybrids are almost essential components of New England gardens. Its tolerance to shearing renders it useful for hedges.

(Continued)

Tsuga canadensis (Common Hemlock)—This native tree has practically no pests here. It develops into an excellent, graceful specimen when standing free. Can be sheared for hedges or to make it more dense. Widely planted here in gardens.

—Donald Wyman

10 conifers for Long Island (New York)

Note: All the species selected are hardy and long-lived and have great beauty at any age. Of all of them the White Pine (*Pinus strobus*) is "tops." The various Chamaecyparis have been omitted because, though fast-growing, they usually are short-lived.

Cedrus atlantica (Atlas Cedar)
Juniperus virginiana (Red-cedar)
Picea orientalis (Oriental Spruce)
Pinus nigra var. nigra (Syn. var *austriaca*) (Austrian Pine)
Pinus parviflora (Japanese White Pine)
Pinus rigida (Pitch Pine)
Pinus strobus (White Pine)—Superb when soil moisture is adequate.
Pinus thunbergii (Japanese Black Pine)—Fine for eastern Long Island and along the North and South shores.
Tsuga canadensis (Common Hemlock)
Tsuga caroliniana (Carolina Hemlock)

—Edwin H. Costich

10 conifers for the New York City area

Abies homolepis (Nikko Fir)—The most successful and most long-lived of the firs here. Remarkably resistant to summer heat and drought.

Chamaecyparis obtusa (Hinoki-cypress)—Its slow-growing cv. 'Gracilis' is with us most satisfactory of all the false-cypresses.

Metasequoia glyptostroboides (Dawn-redwood)—It has been planted here in several different locations and has done extremely well for 20 years.

Pinus parviflora (The Japanese White Pine)—Rather slow-growing but is one of our best conifers. The cv. 'Glauca', with bluish needles, is one of our favorites, being more pleasing than other blue-leaved conifers.

Pinus thunbergii (Japanese Black Pine)—Its asymmetrical habit, as it grows older, gives it a distinctive and special character. It is tolerant of salt spray and wind.

Pinus wallichiana (*P. griffithii*) (Himalayan Pine)—One of our most outstanding conifers. A 45-year-old tree is over 70 feet tall.

Pseudolarix amabilis (Golden-larch)—Particularly valuable for city planting, since being deciduous, it is resistant to air pollution. It is perfectly hardy here and is handsome even in its leafless stage.

Taxus cuspidata (Japanese Yew)—It and its var. *nana* are dependable and excellent here. *T. baccata* cv. 'Repandens' also does very well, and the hybrid *T. media* in the 'Hatfieldii' form is here most outstanding for hedges.

Taxodium distichum (Bald-cypress)—A remarkably beautiful tree at our garden. Two 60-year-old trees, at the shore of a lake, have developed the characteristic root "knees." In dry locations the trees do not seem to do that and, according to our experience, the bald-cypress deserves trial as a street tree.

Tsuga canadensis (Common Hemlock)—The most satisfactory here of the native conifers. It is also easily trimmed into hedges. Sargent weeping hemlock (*T. canadensis* 'Pendula') is exceedingly beautiful.

—Frederick McGourty, Jr.

10 conifers for Philadelphia

Note: The following species were selected for hardiness, longevity, and ornamental value. *Picea abies,* the Norway spruce, was omitted because it is relatively short-lived. *Pinus thunbergii,* the Japanese black pine, though extremely valuable and fast-growing, for much the same reason. *Picea pungens,* the Colorado spruce, and its cultivars were excluded, because one sees them so often planted in the wrong setting.

Abies nordmanniana (Caucasian Fir)
Cedrus atlantica (Atlas Cedar)
Chamaecyparis pisifera (Sawara-cypress)
Metasequoia glyptostroboides (Dawn-redwood)
Picea omorika (Serbian Spruce)
Pinus nigra* var. *nigra (Austrian Pine)
Pinus wallichiana (*P. griffithii*) (Himalayan Pine)
Pseudotsuga menziesii (Douglas-fir)
Thuja occidentalis (American Arbor-vitae)
Tsuga canadensis (Common Hemlock)

—John M. Fogg, Jr.

12 conifers for southeastern Pennsylvania

Abies concolor (White Fir)—The best of the firs. Bluish green.

Abies nordmanniana (Caucasian Fir)—Compact, informal habit. Rich green.

Cedrus atlantica cv. 'Glauca' (Blue Atlas Cedar)—Bluish foliage.

Cedrus deodara (Deodar Cedar)—The cv. 'Kashmir', a hardy selection, with bluish-green, lace-type foliage.

Metasequoia glyptostroboides (Dawn-redwood)—Deciduous. Light green.

Picea abies (Common Spruce)—The cv. 'Inversa' with pendulous branches. Bluish-green color.

Picea omorika (Serbian Spruce)—Pendulous branchlets. Dark green.

Picea orientalis (Oriental Spruce)—Graceful, with short needles. Dark green.

Pinus bungeana (Lace-bark Pine)—Bark conspicuous and interesting.

Pinus cembra (Swiss Stone Pine)—Picturesque shape. Good coloring.

Sciadopitys verticillata (Umbrella-pine)—Attractive shape. Dark green.

Tsuga canadensis (Common Hemlock)—Informal habit. Dark green.

—Russell J. Seibert

10 conifers for the Washington, D.C. area

Calocedrus (Libocedrus) decurrens (Incense-cedar)—For richness of color. Does very well here and deserves to be more widely planted.

Cedrus deodara (Deodar Cedar)—For rapidity of growth, graceful habit, and drought resistance.

Chamaecyparis obtusa (Hinoki-cypress)—For richness of foliage color and relatively slow growth.

Cupressocyparis leylandii (Leyland-cypress)—For good color, very rapid growth, and its tolerance to shearing and shaping. Useable as a tall hedge.

Cupressus glabra (*C. arizonica* of gardens)—For graceful, columnar habit.

Juniperus chinensis (Chinese Juniper)—The cv. 'Columnaris' is one of the best tall junipers. Free of pests. Excellent for screens and wind-breaks.

Juniperus conferta (Shore Juniper)—A procumbent species, is very satisfactory here, especially as a ground cover at the seashore.

Metasequoia glyptostroboides (Dawn-redwood)—For rapidity of growth and the bronze-yellow fall coloring. Not like *Taxodium,* subject to the pest, shoot-moth.

Pinus strobus (White Pine)—The best pine for this area. *P. wallichiana* (*P. griffithii*) is a close runner-up.

Pseudotsuga menziesii (Douglas-fir)—A fine, densely branched tree. Superior to most spruces.

Tsuga canadensis (Common Hemlock)—Does well here. Excellent for background plantings.

Note: For the State of Maryland, with its cold western tip, *Calocedrus, Cedrus, Cupressus* and *Cupressocyparis* have to be omitted. In their place the following are suggested: *Abies nordmanniana, Picea orientalis, Taxus cuspidata,* and *Thuja occidentalis.*

—Henry T. Skinner

10 conifers for eastern Virginia (Norfolk area)

Cedrus atlantica 'Glauca' (Blue Atlas Cedar)—Succeeds well here and is more picturesque than the other cedars. Not as frequently planted as it deserves because plants are expensive.

Cedrus deodara (Deodar Cedar)—Attains a height here of 75 feet, though it is often trimmed. Very hardy and handsome.

Cedrus libani (Cedar of Lebanon)—Symmetrical in its growth and very beautiful. Often used here as a living Christmas tree.

Juniperus virginiana (Red-Cedar)—Native here and very satisfactory in cultivation. Some of its cultivars are frequently planted.

Picea pungens 'Glauca' (Colorado Blue Spruce)—Does extremely well here. Slow-growing, remaining compact. Not much planted because it is expensive. Local nurserymen do not carry it.

Pinus strobus (White Pine)—Does well here, though it frequently suffers from attacks by woolly aphids.

Pinus taeda (Loblolly Pine)—Fast-growing native pine. Used for screen plantings on poor, eroded soils.

Pinus thunbergii (Japanese Black Pine)—Very fast-growing, as much as 2 feet in one season. Very popular. Tolerates ocean spray. Planted for ornament or for screening.

Sequoia sempervirens (Redwood)—Highly satisfactory. One specimen tree here is nearly 100 feet tall. The giant-sequoia or "big tree" (*Sequoiadendron*) does not do as well here.

Taxodium distichum (Bald-cypress)—Native here and usually growing in wet places. Does better and grows faster when planted on dry ground.

Note: Other conifers which do well here are: *Cunninghamia lanceolata, Juniperus chinensis, Pinus palustris, Pinus virginiana, Tsuga canadensis* and *Tsuga caroliniana.* The latter is slow to get established.

—*Frederick Heutte*

10 conifers for northeastern Ohio

Abies concolor (Colorado White Fir)—Unquestionably one of the best firs for the Cleveland area.

Abies homolepis (Nikko Fir)—A very handsome, dark green tree of vigorous growth. Perfectly hardy and highly satisfactory in this area.

Chamaecyparis obtusa (Hinoki-cypress)—The cv. 'Gracilis' is a densely branched, dark green, pyramidal tree of moderate growth rate. Excellent for foundation planting.

Chamaecyparis pisifera (Sawara-cypress)—The cv. 'Boulevard' has recently come into cultivation in this area and is highly recommended. It has soft bluish foliage, is rather slow-growing, and requires little attention.

Juniperus chinensis (Chinese Juniper)—The cv. 'Hetzii' is similar to 'Pfitzeriana' but is an improvement. Rather fast-growing, with glaucous foliage.

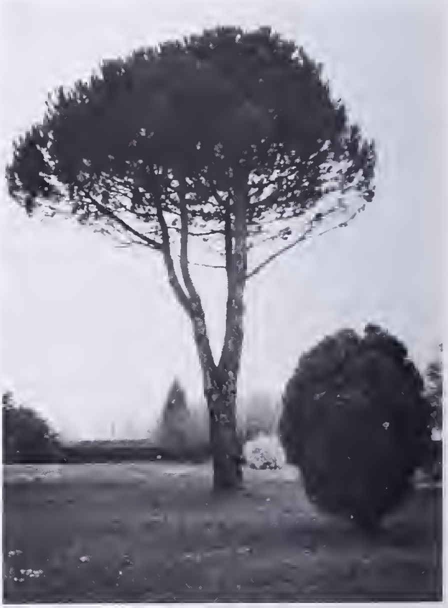
Pinus resinosa (Red Pine)—This pine is being promoted here to replace the Scots pine (*P. sylvestris*), which used to be widely planted but is dying from a so-far-unidentified disease. The long needles on reddish branches make the red pine a choice ornamental tree.

Pinus strobus (White Pine)—A handsome, fast-growing tree. Much used for windbreak planting.

Taxus baccata (Common Yew)—The cv. 'Repandens' is one of the best low-growing yews. Much appreciated and widely planted.

Taxus x media—The cv. 'Hicksii', a medium-size, columnar form of yew is widely used.

Rear view of one of original Sargent hemlocks (*Tsuga canadensis* 'Pendula'), Craig House Sanitarium, Beacon, N. Y.



The unique silhouette of the Italian stone pine (*Pinus pinea*) seen at the Geneva Botanic Garden, Switzerland.

Tsuga canadensis (Common Hemlock)—A superb ornamental tree. Frequently trimmed into hedges.

Note: Other less readily available conifers, which have shown themsleves as highly desirable in the plantings of the Holden Arboretum are: *Abies koreana, Cupressus bakeri* var. *matthewsii* (the only true cypress which is perfectly hardy here), *Calocedrus* (*Libocedrus*) *decurrens, Juniperus virginiana* 'Skyrocket', *Pinus bungeana, P. thunbergii* 'Oculis-Draconis', *P. flexilis, P. schwerinii* (*P. strobus* x *P. wallichiana*) (highly recommended), *Picea pungens* 'Aurea', and *Tsuga diversifolia.*

—*R. Henry Norweb*

10 conifers for southern Michigan (Ann Arbor area)

Abies concolor (White Fir)—Color and form.

Metasequoia glyptostroboides (Dawn-redwood)—Habit and texture.

Picea abies (Common Spruce)—Form, habit and color.

Picea pungens 'Glauca' (Colorado Blue Spruce)—Form and color.

Pinus bungeana (Lace-bark Pine)—Habit, bark and texture.

Pinus nigra var. nigra (Austrian Pine)—Form and texture.

Pinus strobus (White Pine)—Habit and texture.

Pinus sylvestris (Scots Pine)—Form, bark and habit.

Pseudotsuga menziesii (Douglas-fir)—Form and adaptability.

Tusga canadensis 'Pendula' (Sargent Weeping Hemlock)—Form and habit.

—*Richard E. Hanson*

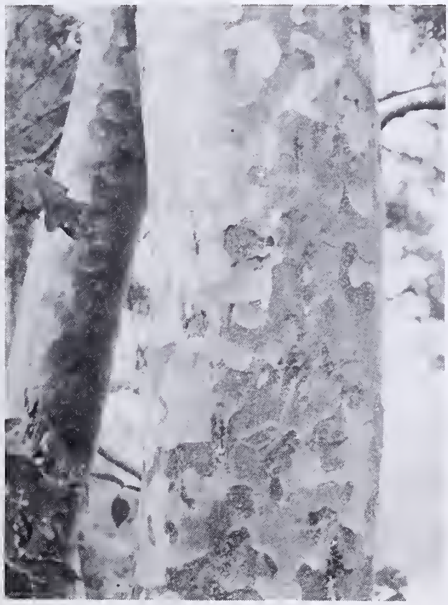
10 conifers for the greater Chicago area

Note: The following species have been selected as having most satisfactorily survived in a great variety of planting sites with minimal care. (This list is particularly interesting in comparison with the list supplied by the Morton Arboretum which is located near Chicago.)

Abies concolor (Colorado White Fir)

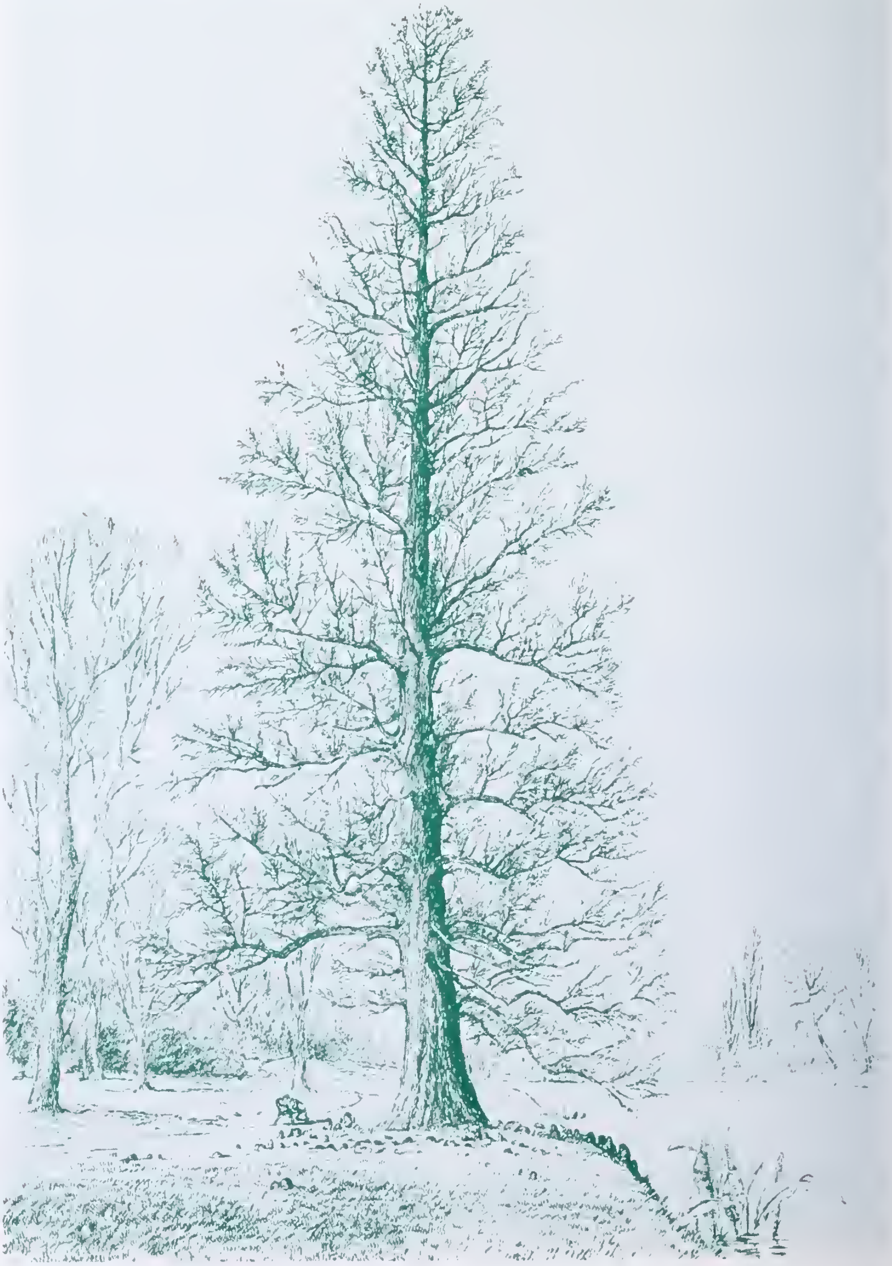
Juniperus chinensis (Chinese Juniper)

Picea glauca cv. 'Densata' (Black Hills



The flaky bark pattern of the lacebark pine (*P. bungeana*) is distinctive and is not unlike the bark of a plane tree.

Japanese red pine (*P. densiflora* 'Umbraculifera') in Brooklyn's Prospect Park. Note its irregular frame and flat top.



The bald-cypress *(Taxodium distichum)* at Syon (near London)—winter effect. (From *Flora and Sylva,* Vol. II, 1902).

Spruce)
Picea pungens (Colorado Spruce)
Pinus nigra var. nigra (Austrian Pine)
Pinus resinosa (Red Pine)
Pinus sylvestris (Scots Pine)
Pseudotsuga menziesii (Douglas-fir)
Taxus cuspidata (Japanese Yew)
Thuja occidentalis (American Arbor-vitae)

—*Francis de Vos*

9 conifers for northern Illinois

Abies concolor (Colorado White Fir)—Tree with greyish-green needles. Tolerates the heavy clay soils of northern Illinois.

Larix decidua (European Larch)—A fast-growing, fine-textured, deciduous tree. Tolerates both high- and low-water tables.

Picea abies (Common Spruce)—A conical tree of rapid growth. Very tolerant of extremes in climatic conditions. Valuable for wind-break plantings.

Pinus armandii (Armand Pine)—Handsome, relatively slow-growing pine, with wide-spreading branches and light green foliage.

Pinus parviflora (Japanese White Pine)—A superb tree of picturesque habit with bluish-green needles. Rather slow-growing but rated highly.

Pinus strobus (White Pine)—The graceful branching habit gives this tree a very high rating, but well-established specimen trees sometimes die suddenly without apparent reason. Midwestern plant pathologists have not yet arrived at a satisfactory answer to this problem.

Pinus wallichiana (*P. griffithii*) (Himalayan Pine)—This graceful species may well be used to replace *P. strobus*. An over-40-year-old tree here is still branched to the ground and is very beautiful.

Pseudotsuga menziesii (Douglas-fir)—An extremely hardy tree and well adapted to Midwestern climatic conditions.

Tsuga canadensis (Common Hemlock)—Outstanding for its fine-textured, dark green foliage, but appears to be sensitive to rapid climatic changes. Succeeds best here when planted over a deep, gravelly sub-soil.

—*Marion T. Hall*

10 conifers for (St. Louis area) Missouri

Note: The intense heat of our summers, often coupled with high humidity and little air-movement, and the dry, cold winds in winter while there is little or no snow cover, severely limit our choice of conifers which succeed in city plantings. High air pollution renders the conditions still more difficult.

Juniperus chinensis (Chinese Juniper)—The cv. 'Pfitzeriana' is completely reliable here under most soil conditions.

Juniperus horizontalis 'Douglasii' (Waukegan Juniper)—Trailing, with ascending branchlets. Steel-blue, with a purple cast in winter.

Metasequoia glyptostroboides (Dawn-redwood)—Fast-growing, conical tree with feathery foliage. Deciduous and therefore resistant to air pollution.

Pinus bungeana (Lace-bark Pine)—Tree of open growth habit. Becoming more handsome with age, when the bark peels off in patches.

Pinus mugo (Mountain Pine, Mugo Pine)—Forms a dense, dwarf, rounded bush, broader than high. Tolerates pinching to make it denser.

Pseudolarix amabilis (Golden-larch)—Deciduous so is less affected by air pollution than other conifers. Golden yellow in fall.

Taxodium distichum (Bald-cypress)—Slower growing than the somewhat similar *Metasequoia*. Surprisingly tolerant of varying soil conditions.

Taxus media 'Brownii'—Dark green. More spreading in habit than cv. 'Hicksii'. Very tough as long as the soil is well drained.

Taxus media 'Hicksii' (Hicks Yew)—Upright growing, densely branched. Dark green.

Thuja occidentalis (American Arbor-vitae) Frequently used for hedges. Its dense, columnar forms are much planted in gardens.

—*Derek Burch*

10 conifers for southern (New Orleans and vicinity) Louisiana

Cedrus deodara (Deodar Cedar)
Cunninghamia lanceolata (China-fir)
Cupressus arizonica (Arizona Cypress)

Juniperus virginiana (Red-cedar)—Native here.

Metasequoia glyptostroboides (Dawn-redwood)—It has been planted since 1952 and should be used more frequently.

Pinus palustris (Long-leaf Pine)—Native here. The most beautiful of the pines.

Pinus taeda (Loblolly Pine)—Fast growing.

Podocarpus macrophyllus (Yew Podocarpus)

Taxodium distichum (Bald-cypress)—Native here.

Thuja orientalis (Oriental Arbor-vitae)

Note—Other conifers: *Juniperus chinensis* 'Pfitzeriana', very satisfactory; *Pinus echinata* (Short-leaf Pine) native here; *Pinus glabra;* native here and suitable for wet sites, edges of lagoons, etc.

Araucaria bidwillii is the only *Araucaria* which succeeds here, but it cannot stand 32°F. or below for several successive nights. Several specimens attained a height of 65 feet (from 1890 to 1965), when three successive cold winters finally killed them.

Sequoia sempervirens has been tried, but it does not tolerate our summer heat. It succeeds only in cool, shaded garden sites where sprinklers are available.

—*J. Ewan*

Conifers for southwestern Louisiana

I had a hard time to find 10 conifers which can be grown here, let alone the 10 best! The following outline of our climatic conditions will explain our difficulties as far as conifers are concerned:

The temperature here averages in January 37.3°F. and in July 81.6°F. The growing days average 278 days. This looks good but is actually misleading. In October the daily minimum is 58 to 60°F, and the maximum 75 to 80°F., very pleasant but often extremely dry. From November on, the minimum may drop for one to three days to the high 30's, and the first frost sometimes occurs before Christmas or not until January. February is the most treacherous month, when a high temperature of 80°F. and warm nights alternate with cold spells of below freezing (sometimes as low as 27°F.) for as long as six hours at night. Regularly warm nights usually begin in March.

Our average annual precipitation is 57.7 inches. The wettest months are July and December; the driest are March and October. The high humidity and the frequent warm spells throughout the year cause many plants, including conifers, to flower two or three times in one season. This exhausts them and many simply refuse to grow and die within a year or so.

In addition, we are handicapped by a high water table, which prevents trees from rooting deeply, so that they are easily blown over by hurricanes. Such trees as *Araucaria bidwillii, Cedrus deodara* and *Cryptomeria,* which otherwise do well, therefore live only from hurricane to hurricane. To set them up again, after they have been blown over, saves them only until the next hurricane. The only conifer which I would add to those mentioned by Dr. Ewan as being highly satisfactory is *Podocarpus nagi.*

—*Sigmond L. Solymosy*

10 conifers for northwestern Texas

Cupressus arizonica (Rough-barked Arizona Cypress)—Native to mountains of Arizona, New Mexico, and Mexico. It has reddish bark.

Juniperus scopulorum (Western Red-cedar) —Native to western Texas.

Juniperus virginiana (Red-cedar)—Native to parts of Texas.

Pinus cembroides var. edulis (Two-leaved Nut Pine, Pinyon Pine)

Pinus flexilis (Limber Pine)—Native to Texas.

Pinus nigra var. nigra (*var. austriaca*) (Austrian Pine)

Pinus mugo (Mugo Pine, Dwarf Mountain Pine)

Pinus pinea (Italian Stone Pine)

Pinus ponderosa (Western Yellow Pine)—Native to Texas.

Pinus thunbergii (Japanese Black Pine)

—*James W. Kitchen*

10 conifers for southwestern Wisconsin

Abies concolor (Colorado White Fir)—Retains its lower branches longer than the "blue" spruces and is less formal in outline.

Juniperus chinensis 'Pfitzeriana'. Good color.

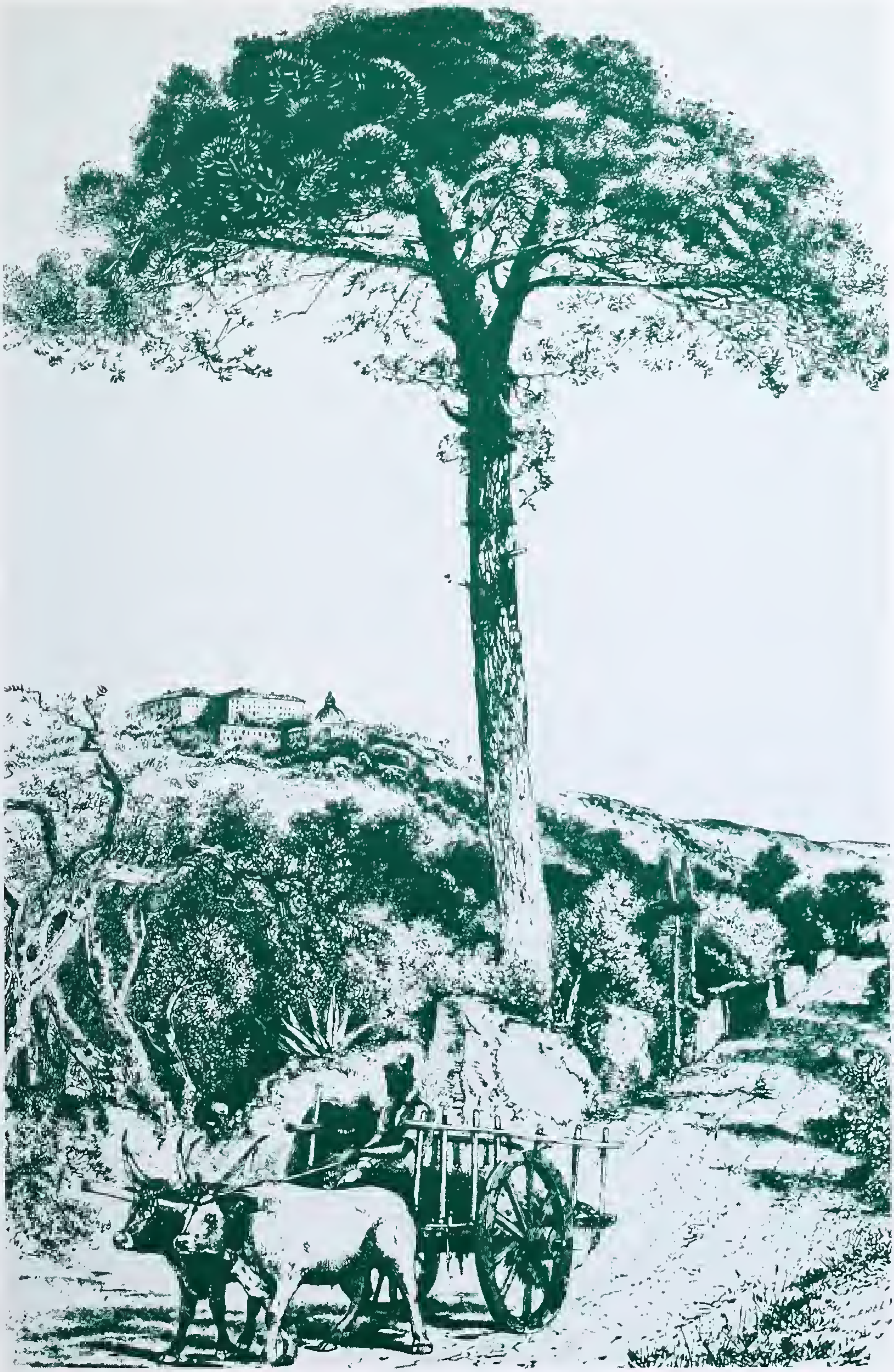
Juniperus horizontalis 'Plumosa'. Horizontal and very regular in outline. "Improved" selections are desirable.

Juniperus virginiana 'Pyramidiformis'. Dense, compact habit.

Picea glauca 'Densata' (Black Hills Spruce) —Slow-growing and of dense habit. Tolerates dry soil and heat.

Pinus mugo var. mughus (Dwarf Mountain Pine, Mugo Pine)—Good textured plant. Always very popular.

Pinus strobus (White Pine)—It possesses freedom from damage by pine shoot moth



Stone pine (*Pinus pinea*) at Castel Gandolfo, Italy. (From William Robinson's *Flora and Sylva*, Vol. II, 1902).

and sapsuckers. Good form and texture.

Pseudotsuga menziesii (Douglas-fir)—Longer-lived than the spruces. Attractive even when the lower branches are lost.

Taxus media—Perfectly hardy. Dense and compact.

Thuja occidentalis 'Techny'—Best foliage color of Arbor-vitae.

—Edward R. Hasselkus

9 conifers for Minnesota

Abies concolor (Colorado White Fir)—A beautiful tree in southern Minnesota but does not succeed much north of St. Paul.

Juniperus chinensis (Chinese Juniper)—This species and all its cultivars.

Juniperus horizontalis (Creeping Juniper)—And cultivars.

Juniperus sabina (Savin Juniper)—And cultivars.

Juniperus scopulorum (Western Red-cedar)—And cultivars.

Picea glauca (White Spruce)—Native to Minnesota. All cultivars and varieties.

Pinus nigra var. nigra (*var. austriaca*) (Austrian Pine)

Pinus sylvestris (Scots Pine)

Pseudotsuga menziesii (Douglas-fir)

—Leon C. Snyder

10 conifers for southern Ontario (Hamilton-Toronto region) Canada

Abies concolor (Colorado White Fir)

Abies lasiocarpa 'Compacta'—This is a dwarf form of the Alpine Fir.

Chamaecyparis nootkatensis (Nootka-cypress)—The cultivar 'Pendula' is especially graceful.

Larix kaempferi (*L. leptolepis*) (Japanese Larch)—Blue-green foliage. A handsome tree, useful for most landscaping purposes.

Picea omorika (Serbian Spruce)

Picea orientalis (Oriental Spruce)

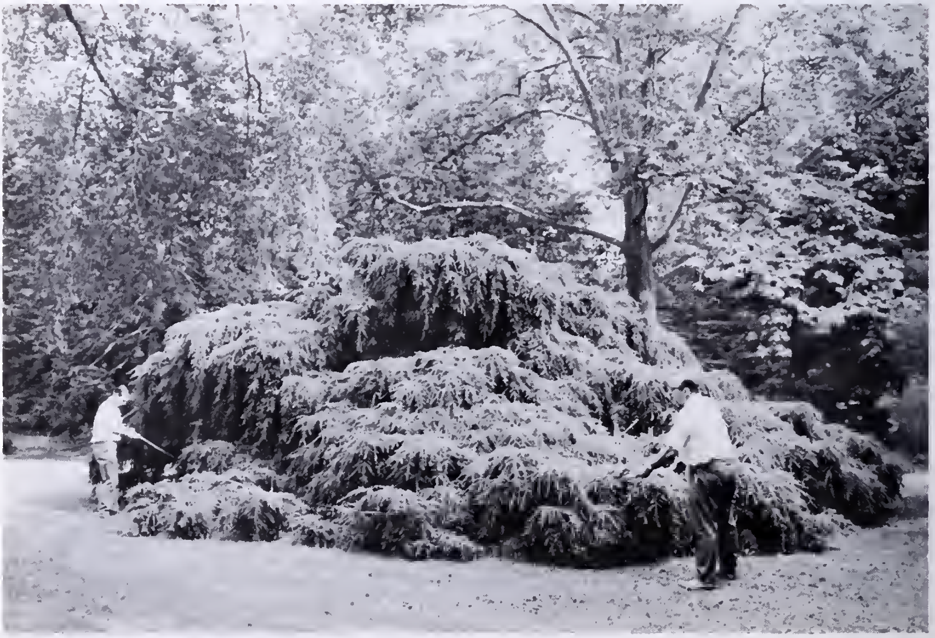
Pinus nigra var. nigra (*var. austriaca*) (Austrian Pine)

Pseudotsuga menziesii (Douglas-fir) — We like var. *glauca*, the Rocky Mountain form.

Thuja plicata (Giant Arbor-vitae)

Tsuga canadensis (Common Hemlock)

—Leslie Laking



Morris Warman

Sargent hemlock (*Tsuga canadensis* 'Pendula'), Cutting Arboretum on Long Island

10 conifers for central and southern regions of the province of Alberta, Canada

Abies balsamea (Balsam Fir)—Native to northeastern Alberta. Occasionally planted as a specimen tree.

Larix rossica (*L. sibirica*) (Siberian Larch) —Rapid-growing tree, with slightly drooping branches. Very attractive. Colors bright yellow in fall.

Picea abies (Norway Spruce)—Graceful specimen tree.

Picea pungens (Colorado Spruce)—Hardy and widely planted in many color forms, some steel-blue. Usually keeps its branches to the ground.

Pinus contorta var. latifolia (Lodge-pole Pine)—Native to central and northwestern Alberta. Yellowish-green needles. Good specimen tree.

Pinus flexilis (Limber Pine)—Native to southwestern Alberta. A graceful specimen tree.

Pinus nigra var. nigra (Austrian Pine)—Rather slow growing but compact and attractive.

Pinus ponderosa (Western Yellow Pine)—Native to Alberta but quite rare. Slow-growing but young trees very attractive. Good specimen tree.

Pinus sylvestris (Scots Pine) — Somewhat asymmetric in shape. Requires space for development. The reddish bark is conspicuous in winter.

Pseudotsuga menziesii (Douglas-fir)—Hardy but very variable. In good forms it is well branched to the ground. Good specimen tree.

—*P. N. D. Seymour*

10 conifers for Colorado (Denver region)

Abies concolor (Colorado White Fir)—Native to Colorado.

Juniperus chinensis 'Pfitzeriana', also 'Pfitzeriana Compacta' (Pfitzer Juniper)

Juniperus horizontalis 'Wiltoni' (Wilton's Creeping Juniper)

Juniperus scopulorum (Western Red-cedar) —Native to Colorado.

Juniperus scopulorum (Rocky Mountain Juniper)—The cv. 'Blue Heaven' with blue foliage, is excellent. *(Continued)*

Jerome Eaton

Korean pine *(P. koraiensis)* growing at Long Island's Old Westbury Gardens.

Scots pine *(P. sylvestris)* growing in Green-Wood Cemetery, Brooklyn, N. Y.

Juniperus virginiana (Red-cedar)

Picea pungens (Colorado Spruce)—Native to Colorado.

Picea pungens 'Glauca' (Colorado Blue Spruce)

Pinus aristata (Bristlecone Pine)—Native to Colorado.

Pinus nigra var. nigra (Austrian Pine)

—*James R. Feucht*

10 conifers for Utah

Abies concolor (Colorado White Fir)—Native to the mountains of Utah. Frequently planted for ornament and also highly prized as a Christmas tree.

Picea glauca **'Densata'** (Black-Hill Spruce) —Very compact and symmetrical in its habit of growth. Green to bluish-green.

Picea pungens (Colorado Spruce)—Native to Utah and widely planted for ornament. Rather formal in appearance and a focal point in any landscape planting.

Picea pungens cv. 'Argentea' (Koster's Blue Spruce)—One of the most spectacular of all the conifers. Bright blue and of stately appearance.

Pinus cembroides var. edulis (Nut Pine, Pinyon Pine)—Native to the foothills in Utah. Tree of short bushy growth and easily trimmed. This, as well as var. *monophylla,* are used in the Southwest extensively as Christmas trees.

Pinus mugo (Dwarf Mountain Pine, Mugho Pine)—Frequently planted for ornament in gardens.

Pinus ponderosa (Western Yellow Pine)—Native to Utah and a valuable timber tree. Planted also for ornament, especially in spacious public grounds.

Pinus strobus (White Pine)—A rapid growing tree, unsurpassed for its soft, long, green foliage. Equally beautiful in a formal or informal landscape setting.

Pinus sylvestris (Scots Pine)—A large, spreading, round-headed tree with bluish-green needles, which provide color contrast.

Pseudotsuga menziesii (Douglas-fir)—Native to Utah and a valuable timber tree. Easily trimmed to make it more dense and ideal for informal landscape plantings. Very popular also as a Christmas tree.

Note: All these conifers have been selected for their tolerance to our predominantly alkaline soils.

—*Cecil M. Jorgensen*

10 conifers for southern California (Los Angeles area)

Calocedrus (Libocedrus) decurrens (Incense-cedar)

Cedrus atlantica 'Glauca' (Blue Atlas Cedar)

Cedrus deodara (Deodar Cedar)

Cupressus sempervirens (*var. sempervirens, var. stricta*) (Italian or Mediterranean Cypress)

Juniperus chinensis cv. 'Pfitzeriana Glauca' (Pfitzer's Blue Juniper)

Pinus canariensis (Canary Island Pine)—A three-leaved pine with long, slender leaves and big cones.

Pinus pinea (Italian Stone Pine)

Pinus thunbergii (Japanese Black Pine)

Podocarpus macrophyllus (Yew Podocarpus)

Thuja orientalis 'Sieboldii' (Low and compact form.)

—*William S. Stewart*

10 conifers for northern California (San Francisco region)

Abies concolor (Colorado White Fir)—The graceful pyramidal outline, soft, glaucous foliage, and ease of cultivation make this the most satisfactory fir.

Calocedrus (Libocedrus) decurrens (Incense-cedar)—The finest of all coniferous trees when a columnar effect is desired.

Cedrus atlantica 'Glauca' (Blue Atlas Cedar) —Superior to the Lebanon cedar as an ornamental and, certainly more beautiful.

Chamaecyparis lawsoniana (Lawson False-cypress)—Choice for its slender, pyramidal habit and the soft, slightly pendulous branchlets.

Picea pungens cv. 'Argentea' (Koster's Blue Spruce of the trade)—Magnificent tree of perfect symmetry with lovely silver-blue foliage.

Picea smithiana (West Himalayan Spruce) —A handsome, broadly pyramidal tree, becoming pendulous in habit as it matures.

Pinus canariensis (Canary Island Pine)—A most graceful pine with long needles, slender pyramidal in its habit of growth.

Pseudotsuga menziesii (Douglas-fir)—A majestic, fast-growing tree. Not fastidious as to soil conditions and very satisfactory here.

Sequoiadendron giganteum (Big Tree)—A prodigous species of massive proportions, inspiring with its rugged strength.

(Continued)

Weeping Norway spruce *(Picea abies* 'Inversa') at New York Botanical Garden.

John J. Tyler Arboretum

Giant-sequoia or "big tree" at Tyler Arboretum, Lima, Pa. About 129 years old. ►

Yew topiary examples at Longwood Gardens.

Tsuga heterophylla (Western Hemlock)—A lovely tree, graceful, feathery in outline and with fresh green needles on drooping branchlets. The "buggy whip" top is characteristic for this species.

Note: Cupressocyparis leylandii is another conifer valued highly in this area because of its wind-resistance.

—*P. H. Brydon*

10 conifers for the Puget Sound area (Washington)

Abies lasiocarpa (Alpine Fir)—Native in our mountains here. Very satisfactory in cultivation and highly ornamental. Rather slow-growing and compact. Var. *arizonica* has more silvery leaves.

Abies procera (*A. nobilis*) (Noble Fir)—Quite common in Mt. Rainier National Park (Washington). Much faster growing than *A. lasiocarpa* and has reached here 30 feet in 20 years. Leaves glaucous on both sides.

Calocedrus (Libocedrus) decurrens (Incense-cedar)—A valuable, columnar tree of moderate growth rate. Hardy and free of diseases and pests. Prefers a sunny, well-drained position. Tolerates city park conditions.

Cedrus deodara (Deodar Cedar)—The most commonly grown cedar through the Pacific States. More attractive is *C. atlantica* 'Glauca'.

Chamaecyparis lawsoniana (Port Oxford-cedar, Lawson False-cypress)—Widely grown in this region in many forms. Unfortunately, it is now threatened by Phytophthora root rot for which so far we have no cure.

Chamaecyparis nootkatensis (Nootka False-cypress)—The cv. 'Pendula' is the most graceful ornamental conifer grown in this region. Grayish-green. Reaches 50 to 60 feet.

Picea pungens 'Glauca' (Blue Colorado Spruce)—Highly ornamental and widely planted. In spite of our rather damp climate it has attained here a height of 80 feet in about 55 years. It needs one or two insecticide sprays in spring and summer to combat aphids and spider mites.

Pinus sabiniana (Digger Pine)—Absolutely hardy here. Selected for its open, airy appearance, rounded shape, long, slender, grey-green needles, freedom from diseases and pests, and its tolerance to varying soil conditions. *P. contorta, P. densiflora, P. sylvestris* and *P. thunbergii* are also frequently planted in and around Seattle.

Sciadopitys verticillata (Umbrella-pine)—Handsome pyramidal tree, with dark green, glossy foliage. Deserves much wider use.

Tsuga mertensiana (Mountain Hemlock)—Native in our mountains here. It does ex-

Planting balled-and-burlapped evergreens

1 Dig hole larger than tree's ball, adding peat moss if the soil is sandy.

2 Plant tree with root ball at same level as in former position. Loosen, but do not attempt to remove burlap.

tremely well and is free of diseases and pests. Attractive at all seasons.

Note: Our climate, with moderate summer and winter temperatures and with an annual rain-fall of 30 to 40 inches, permits us to grow a large variety of conifers, including many species of *Cupressus,* as well as a large number of pines, junipers, hemlocks, firs and others such as *Cryptomeria* and *Cunninghamia.* A selection of 10 is not easy. *—Bryan O. Mulligan*

10 conifers for British Columbia, Canada (Vancouver area)

Araucaria araucana (Monkey-puzzle Tree)—Many fine specimens are on the lower mainland and on Vancouver Island. Usually branched to the ground. Some coned heavily last year.

Cedrus atlantica 'Glauca' (Blue Atlas Cedar)—Attractive, bluish-grey tree. Very popular here.

Cedrus deodara (Deodar Cedar)—Beautiful, graceful tree, with pale-green foliage. Broadly conical. Usually branched to the ground.

Cryptomeria japonica (Cryptomeria)—Picturesque tree of compact branching habit. Occasionally injured here in bad winters.

Cunninghamia lanceolata (China-fir)—Perfectly hardy. Somewhat shrubby. Light green. Frequently sheds some branches, rendering it untidy.

Pinus ponderosa (Western Yellow Pine)—Native to interior of British Columbia. Tall tree of round outline. Becomes very massive when planted in the high rainfall area at the coast.

Pseudotsuga menziesii (Douglas-fir)—Native here and a valuable timber tree. Not as graceful as cedar and hemlock but develops into a stately and beautiful specimen when not crowded.

Thuja plicata (Giant Arbor-vitae)—Native here. Develops into a superb specimen when given enough space, the branches sweeping the ground.

Tsuga heterophylla (Western Hemlock)—Native here. Very graceful, dark green tree. Most attractive when planted with deciduous trees.

Sequoiadendron giganteum (Big Tree)—The coastal redwood (*Sequoia sempervirens*) is not reliably hardy here, but the "big tree" from the Sierras is quite at home. A tall, compact, very attractive tree.

Note: Chamaecyparis lawsoniana (Lawson False-cypress)—Has been frequently planted here but can no longer be recommended. It is attacked by Phytophthora root rot, and several beautiful 50 foot specimens have been lost because of it. So far there is no remedy. *—J. W. Neill*

3 Tramp soil firmly around edges of root ball to eliminate air pockets.

Holly Lull

4 Water plants generously. A mulch of leaf litter helps to keep soil moist.

Marjorie J. Dietz

Ginkgo trees in front of Philharmonic Hall in New York's Lincoln Center.

THE REMARKABLE GINKGO

Maunsell Van Rensselaer

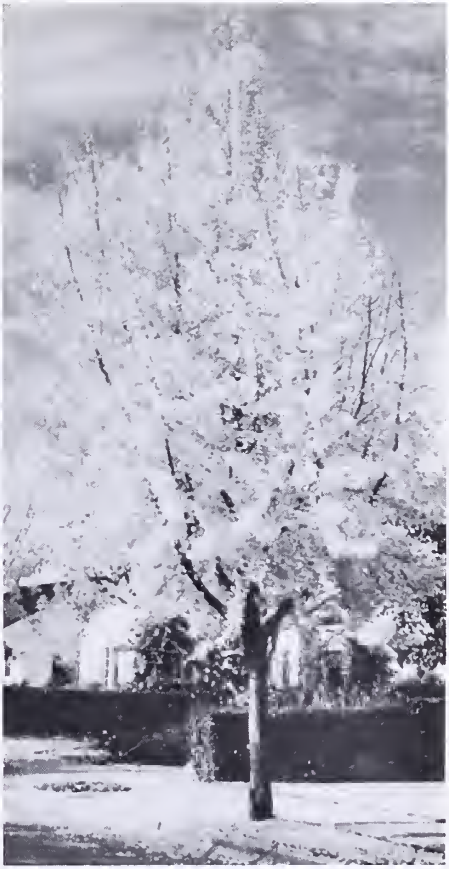
THE GINKGO is a living relic from long past ages. Fossil remains show that it and its extinct near relatives were once widely distributed over the whole Northern Hemisphere. Although presumably unknown in the wild state, it has since been reported to be growing wild in a remote part of eastern China. The ginkgo (also known as the maidenhair tree), although the sole species and genus of the ginkgo family, is a resinous tree, and is unquestionably rather closely related to the conifers.

The ginkgo, which may reach a mature height of well over 100 feet, is a very long-lived tree, as it is not preyed upon by diseases and pests. A tree in Japan is known to be at least 1000 years old. The ginkgo also shows an extraordinary ability to adjust to a wide variety of climates. It is hailed as one of the most satisfactory ornamental trees for southern Louisiana, where only occasionally do even mild frosts occur. Yet it is perfectly hardy and highly appreciated in southern Canada and other regions where winter temperatures may drop to 25 degrees below zero.

In 1730 the ginkgo was introduced into European gardens from the Orient; into America, about 1784. The large tree in John Bartram's garden in Philadelphia is likely the oldest in the U.S.

Donald Jones

Male catkins of ginkgo appear in profusion as the foliage unfolds in spring.



M. Van Rensselaer

Ginkgo 'Autumn Gold', a superior male form with upright, ascending branches.

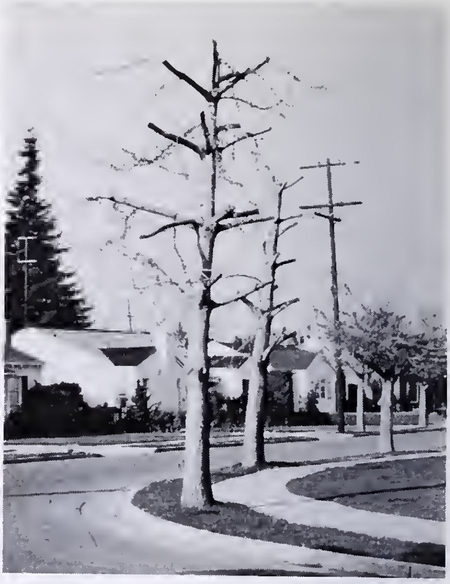
The ginkgo develops into an imposing and handsome tree of distinctive appearance. Its fan-shaped leaves color bright yellow in autumn before they drop. It succeeds well under urban conditions and is remarkably resistant to air pollution, in part undoubtedly because of its deciduous foliage. For best results, it should have a deep, fairly rich soil, as well as occasional deep watering.

Although it has been frequently stated that this tree is slow growing, the average annual growth of vigorous young trees in the test plots of the Saratoga Horticultural Foundation at Saratoga, California, has been from 2 to 3 feet in their early years, which is greater than many trees.

The sexes of ginkgo are separated on different trees and the large, plum-shaped fruits of the female tree have an extremely unpleasant odor. Such a trait is particularly objectionable in street plantings. Otherwise, the ginkgo makes an ideal subject for street planting. The large, hard and round kernel of the fruit can easily cause a pedestrian to slip and fall, and clothing stained with the juice is ruined, because no cleaning will remove the odor. The juice can even cause skin irritations as serious as those from poison-ivy. Another disadvanatage to plant-

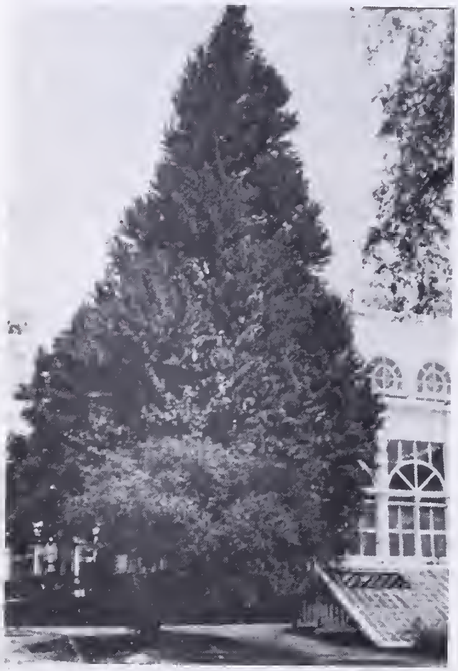
(Continued)

Ginkgo story with a sad ending: this California city street was planted with seedlings, unsorted as to their sex.



M. Van Rensselaer

Many seedlings were females and bore foul-smelling fruits. The enraged residents then stubbed the trees, as shown.



The parent tree of Ginkgo 'Fairmount'.

ing unknown seedlings of ginkgo trees along streets is that such trees frequently produce irregular branches, which jut out at odd angles, spoiling the symmetry considered desirable in street trees. Fortunately, it is not necessary to plant either female ginkgo seedlings or seedlings of poor growth habits, as both of these disadvantages can be overcome through vegetative propagation—selecting grafts and cuttings from male trees of good growth habits.

Since 1951, the Saratoga Horticultural Foundation has conducted a search throughout the United States and Europe for shapely and desirable male trees. Seven of these are now assembled at Saratoga, and all are growing well in the test plots. The first to be distributed to nurserymen has been named 'Autumn Gold'.

The ginkgo is a popular street tree throughout the world. *Above:* Ginkgo trees line the main approach to the ~~Imperial Palace~~ in Tokyo. *Below:* Planting in New York.
Diet Building

It has ascending branches and develops a symmetrical, oval crown. It is especially recommended for street planting. Another, which is attracting wide attention, is 'Fairmount', a strong-growing tree with a dense, conical crown. The present tree of this selection is growing in Fairmount Park, Philadelphia, Pennsylvania, adjacent to the site of the 1876 Centennial Exposition and was probably planted there at that time. *Editor's note:* Ginkgo, a tree long considered all but immune to the effects of air pollution, has recently come under a cloud of suspicion in some metropolitan areas. Dr. Russell J. Seibert, Director of Longwood Gardens, Kennett Square, Pennsylvania, reports that ginkgo is now showing symptoms of air pollution damage on Philadelphia streets. ◆

The right specimen and techniques are necessary when

MOVING LARGE CONIFERS

TREES SELECTED for moving must be vigorous specimens, making good annual growth. They should be selected from well-spaced plantings where lower branches are not heavily shaded. Trees from crowded plantings frequently have lower branches shaded out or are weakened and dying from too much shade, and can not be depended on to fill out or to become well-rounded when planted where space is ample. New branches are not likely to be produced and those already weakened will die.

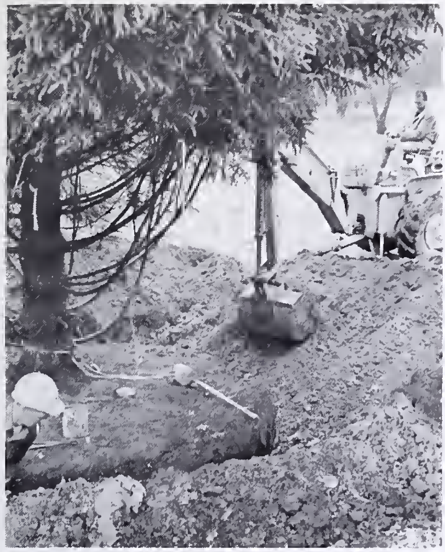
For a large tree the planting site must be accessible for heavy equipment and suitable for the growth of conifers. Good drainage is essential. Air pollution is a hazard, and such factors as reflected heat from roads and buildings should be considered. Spruce trees are especially vulnerable to air pollution. The immediate neighborhood can be checked for healthy specimens of the kinds desired for transplanting. The condition of existing trees is a good barometer for measuring air pollution effects. Conifers can be transplanted at any time, but early spring and early fall are best.

After the tree has been selected, the next step is to dig the ball. The size of the ball is usually determined by the trunk diameter. Small trees up to 6 inches in trunk diameter are measured 6 inches above ground level; all larger trees, one foot above ground level. Normally, trees up to 20 inches in trunk diameter can be moved successfully. Limiting factors are the weight of the ball and tree and the equipment available to do the job. Measure 9 inches of ball for each inch of trunk diameter, although this may vary with some kinds. Use a tape or a stick cut to the right length to make a circle. After the desired size of the ball has been determined, dig a trench around the tree. It is best to make the ball a few inches larger in diameter than the finished ball will be. This allows for trimming to eliminate irregularities in digging. In cutting any but the smallest roots, care should be

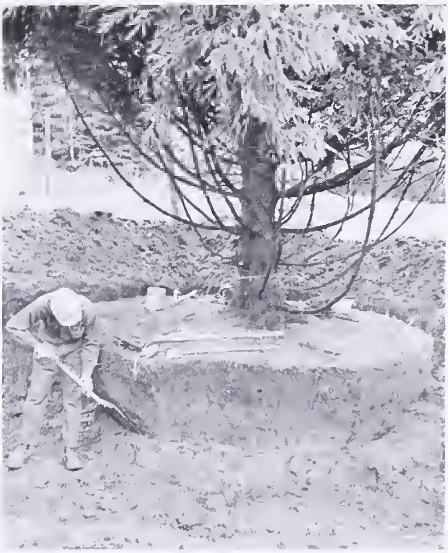
All photographs from Davey Tree Expert Company

1 Measuring to determine size of root ball. The ball must be tight and compact to prevent breaking in process of moving.

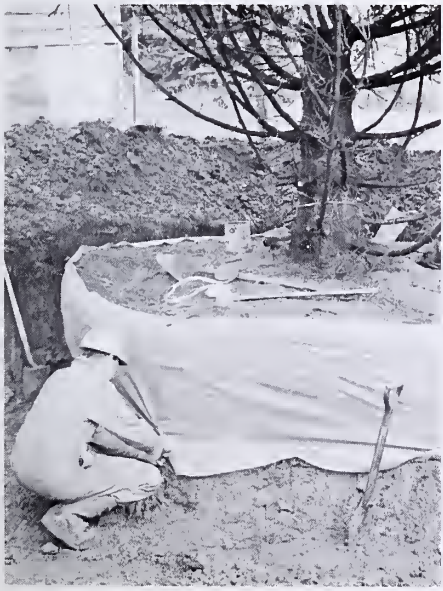
2 Start digging the trench a few inches outside of final measurement of ball. Do not walk on ball; cut torn roots cleanly.



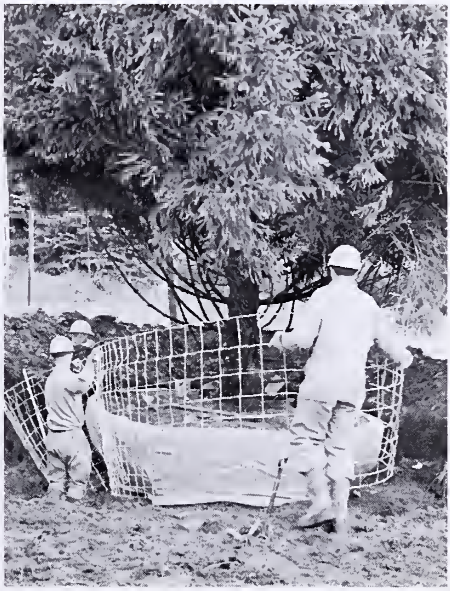
3 Heavy equipment, such as this back hoe, can be used to dig large trenches, or to clean soil from trench for easier working. It can also be used to prepare a ramp on one side of tree in preparation for moving by winch onto truck.



4 Final shaping of root ball. It must be equally wide all around. Start at the top, tapering the ball to the bottom. This is the last chance to make certain the ball is the right size and that soil is held firmly by the roots.



5 Wrapping the ball with burlap. An extra 4 inches or so is allowed at top and bottom. Pin pleats with nails.



6 After burlap is in place, the ball is given additional support with rope or wire fencing, called "hog wire."

(Continued)

taken not to jar and loosen the soil within the ball. Large roots should be cut with root cutter or hand pruners which do not jar the ball, and which leave a smooth wound most favorable for rapid healing.

The depth of the ball is determined by the root system. Trees with good fibrous root systems transplant well. A coarse-rooted or tap-rooted tree may not move well. Dig down below the root system, usually between 20 to 40 inches. Then, dress down the ball. Start at the top edge and cut it in as you go down, about the shape of a rounded tea cup, keeping root cuts tight to the ball. Care must be taken not to bump or step on the ball until it is wrapped. Clean out the trench.

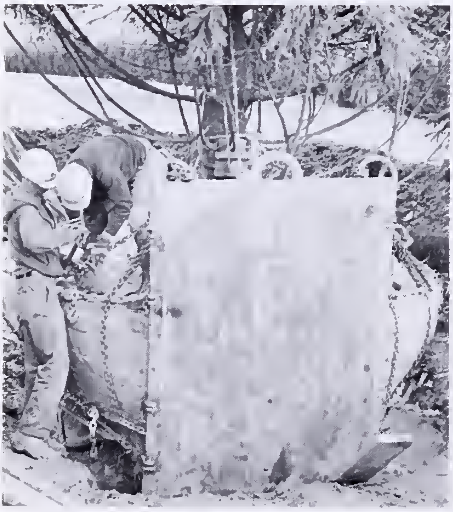
The next step is wrapping of the ball. Spiral burlap around the ball, leaving about 4 inches below the bottom of ball. Use nails for pinning; fold back small pleats and pin around bottom, then do the same around the top, drawing burlap snug all the way around. After wrapping is completed, then rope or wire the ball. There are many methods of applying rope, cord or wire. The drum lace is one commonly-used method on larger trees. Professional tree movers sometimes use a fencing or wire material called hog wire.

There are many different methods used to move the tree from the hole. A chain cradle (built like a large tire chain) is commonly used and goes around the ball after burlap and wire or rope are in place. A hydraulic crane with extendible boom for lifting the tree is ideal. However, cranes are limited in the amount of weight they can handle. A 6-foot ball is about the limit. In some cases, a platform or skid is used and the tree is loaded by means of a winch. Special-built tree movers are often used for moving large trees. Regardless of the method, all points of pressure or strain on the trunk must be well-padded and protected. The bottom of the ball should be covered with burlap, wire, or a tarpaulin laced to the ball.

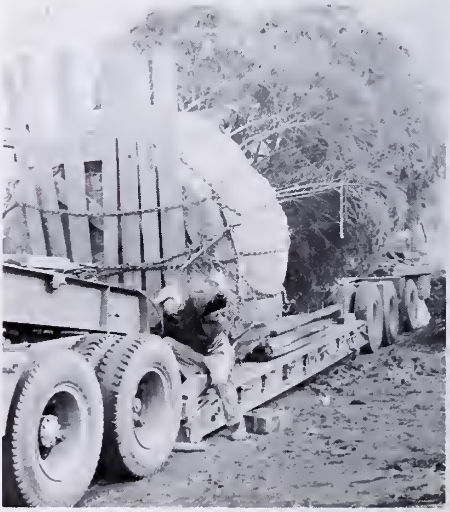
Care must be taken in tying in the branches. Always fold them toward the top of the tree, and tie each branch individually. The large tree must be made narrow enough to take on the highway. The entire tree should be covered with burlap to avoid scorching or burning and to keep winter salt deposits off branches.

All local load limits—height, width, length, and weight—must be checked before the tree is moved. Low wires, bridges, trees, and other hazards along the route should be checked.

The pit is prepared for the tree before



7 A chain cradle is around root ball, skid board is in place, with rollers ready for removal of tree by winch.



8 Tree is on trailer truck and ready for transporting. All the branches have been carefully drawn in and tied.

it arrives at its new site. The pit should be larger than the ball in order to allow for proper fillback and watering. When setting the tree in the pit, it is necessary to continually check the grade level. The tree should be as near to grade as possible, taking care that the tree is not planted too deep. The tree must be standing straight when planting begins. A temporary rope can help hold the top in place until planting is complete. On a slope or bank, set the front level and the back well below grade. Care must be taken to avoid covering the top of the ball with soil. Sand, gravel, stone, or mulch may be used to bring up to grade after the planting has been done.

When digging the pit, you create a pocket. This is true on a hilltop, steep slope, or level ground. Use good soil in planting; top soil and sandy loam are best. It is good to add peat moss, humus, leafmold, or a small quantity of well-rotted manure to the planting mixture. Heavy sod clumps should not be used.

After the trench is filled, use a garden hose to run water in the trench until it is saturated. Use a spading fork or spade to puddle this soupy mixture all the way to the bottom of the pit to help eliminate air pockets. Then, fill the trench to ball-level with planting mixture.

Using just soil, build a 6- or 8-inch water ring over the top of the backfill around the ball. This water ring will help hold water during the maintenance period. On a sloping site, put the water ring on the down-hill side. Avoid moving any soil on top of the ball.

It is advisable to use guys to protect against strong winds. Usually three are sufficient. Place guys about two-thirds of the distance from the ground to the top of the tree, using a hose to protect the bark. Lag hooks which screw into the trunk may also be used. Guy wires or light cable are then fastened to stakes or anchors in the ground. The guy wire should be at a 45° angle at the top of the tree. Bury the stake or anchor about 3 feet deep and wrap cable around its center. About 2 feet above ground, install a 3/8- or 1/2-turnbuckle. Make certain all guys are taut.

Inside water ring, place a 3- or 4-inch mulch of wood chips, rotted manure, tanbark, leafmold, or almost any type of mulch. Once planting has been completed, set up a rigid watering program and adhere to it for two or three years. This means a deep saturation of water, usually once a week during dry periods. ◆

9 The evergreen has reached its new location and is being lowered into its planting hole which had been previously prepared. The root ball level should be the same as it was prior to removal. Regular watering continues for 2 years.

The greater use of conifers has increased disease problems

DISEASES OF EVERGREENS

Donald F. Schoeneweiss

EVERGREENS IN GENERAL have long been considered relatively disease-free. When one compares the many diseases of deciduous trees and shrubs to the few really serious disease problems of evergreens, this idea seems to have merit. Because evergreens have been touted as low maintenance plants, they have been used extensively, and at times overenthusiastically, in landscaping. Unfortunately, most diseases of evergreens that become real problems occur on large, well established and valuable specimen plants. The loss of a few branches of a mature evergreen, due to damage caused by disease organisms, can alter the shape of the plant and detract from its natural beauty for many years. Removal and replacement of such large plants is often prohibitively expensive.

Most of the important evergreen diseases generally appear on plants that are low in vigor or are in a weakened condition. Such a condition may result from drought, flooding or suffocation of the root system, extreme temperature fluctuations, frost or freeze damage, lack of nutrients, chemical or mechanical injury, or heavy attacks by insects or nematodes. The fact that evergreen species seem to grow well in a native stand does not imply that they will grow equally as well under the unnatural conditions of a landscape planting. The root systems of all woody plants require a proper balance of water, air, and nutrients to remain in a vigorous condition. In a landscape planting, the existence of a turf or sod cover over the root system of an evergreen can result in the depletion of soil moisture and nutrients to the point where periodic watering and fertilization are necessary to maintain vigor.

Since treatment or eradication of plant diseases—once they have become established—is far more difficult than disease prevention, effective protection from attack by disease organisms begins with selection of a suitable planting site, proper plant maintenance, the selection of disease-resistant types, and in some cases the application of protective sprays. Although research on control of diseases has lagged behind production of evergreens and introduction of new varieties and selections, effective control measures have been worked out for many evergreen diseases and should be employed wherever possible. The effective use of proven disease control practices will not only benefit the plant in question but will aid in preventing the buildup of disease organisms which may be spread to other potential host plants. Control recommendations for many plant diseases may be obtained from state and federal research organizations, and are usually based upon scientific experimentation. Such recommendations, if followed closely, will give better results in the long run than hit-or-miss measures suggested by untrained or poorly informed individuals.

Diseases of evergreens may be separated into five categories: leaf or needle diseases, twig and stem diseases, root diseases, wood decays and rots, and diseases or injuries not resulting from attack by living organisms. Control practices for specific diseases within each category are often quite similar, and some of the practices are effective on several diseases within the category.

Leaf or Needle Diseases

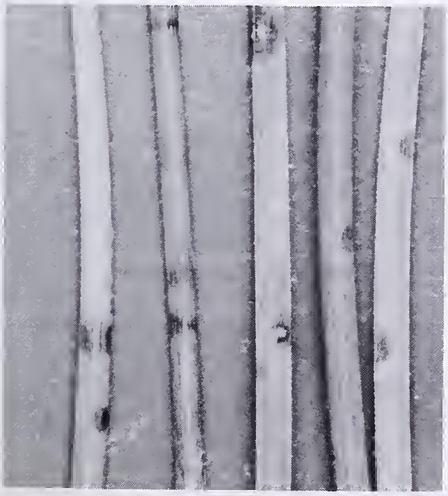
Although many fungi may infect evergreen foliage and cause needle cast, blight, or rust, only a few result in sufficient damage to warrant control measures. Most of the fungi found on needles attack older needles or those that are heavily shaded, but considerable damage can occur on needles of injured or weakened plants. Cool, wet weather usually favors disease development and may result in local epidemics of needle diseases.

Needle casts

A large group of fungi may cause defoliation or needle cast of coniferous plants. Most of these fungi attack older needles or those in a weakened condition and seldom cause any significant damage. Affected needles turn brown and defoliate readily. Numerous small, black fungus fruiting bodies form in diseased tissues. Although needle casts can be controlled by applying foliar sprays containing organic mercury or copper fungicides, usually in early spring, damage caused by these fungi seldom warrants control measures.

Needle blights

Many fungi are associated with blighting of evergreen foliage but only a few cause enough damage to necessitate the application of preventive sprays. One of these, known as *Scirrha pini (Dothistroma pini),* may attack Austrian pine, ponderosa pine, Japanese black pine, and occasionally other pine species, and can result in extensive damage even on vigorous, established specimens. Although the fungus invades the current season's needles, typical symptoms—which include spotting and banding of needles—appear during the season following infection.



Spots or lesions on Austrian pine needles caused by pine needle blight fungus.

Pine needle blight, as the disease is commonly called, may result in extensive defoliation and weakening of affected plants to the point where they may succumb to low temperature injury, drought, or insect attack. Although considerable variation in disease susceptibility of individual specimens has been observed, particularly among Austrian pines, resistant varieties or selections are not available. The only effective control measure developed thus far is the application of copper-containing fungicides such as Bordeaux mixture (8-8-100). Two sprays at 10-day intervals should be applied in early spring on existing foliage, and two additional sprays at 10-day intervals should be applied in July to protect the current season's needles.

Another disease which can cause extensive damage in a landscape planting is Cercospora blight. The disease fungus attacks the foliage of juniper, arbor-vitae, and cypress, beginning at the base of the branches and spreading until only a tuft of green foliage remains on the branch tips. Severely affected plants may die in 2 to 3 years. Satisfactory control has been achieved through the application of several sprays of organic mercury or copper fungicide in July and August.

Needle rusts

Rust pustules on leaves or needles of evergreens are frequently striking in appearance but seldom, if ever, cause any significant damage. Most of the rust fungi require an alternate host plant, usually a deciduous species or a weed host, to complete their life cycle. Where possible, removal of the alternate host should reduce the amount of infection. Recommendations should be obtained from state or federal agencies.

Browning and defoliation of needles

Browning and loss of older needles in late summer and fall is normal for most evergreens, and is comparable to autumn coloration and leaf drop of deciduous trees and shrubs. Adverse climatic conditions—drought, insect attack, or a general weakening of the plant—may accentuate needle drop and, under extreme conditions, all but the current season's needles may defoliate. No control measures are recommended other than watering during dry periods and occasional fertilizer application to maintain plant vigor.

When evergreen foliage develops an off-color or russetted appearance, plants should be examined carefully for small animals called mites or spider mites. These tiny creatures can increase in numbers rapidly during periods of favorable weather if not controlled by miticide sprays. Spruce, fir, hemlock, and juniper species should be sprayed regularly for mite control.

Twig and Stem Diseases

Organisms causing twig and stem diseases on evergreens are often found on plants low in vigor or weakened in some way. Many disease organisms found on stems, such as the canker fungi, are wound-invading parasites which enter the plant through a break or wound and, if the tissues are weakened, cause a localized infection. Others, such as the fungi which cause twig blights and rusts, enter through needles and colonize stem tissues. If stems become girdled by canker fungi or other stem disease organisms, extensive dieback can occur.

Twig blights

The fungus disease known as juniper blight attacks many juniper varieties and selections as well as arbor-vitae, cypress, and false-cypress. The disease fungus, *Phomopsis juniperovora*, invades young twig tips in early spring and results in girdling and death of affected twigs by early summer. On highly susceptible varieties, the disease may progress until large branches and occasionally entire plants are killed. A typical symptom of juniper blight is the formation of small, black fungus fruiting bodies on stems at the base of the blighted tissues. Spores produced in these fruiting bodies are released during wet weather and may be spread to healthy plants on pruning or shearing tools or by driving rains. For this reason, all diseased twigs should be disinfected periodically with strong bleach or alcohol. Susceptible plants may be protected by the application of sprays containing organic mercury fungicide or a copper-containing fungicide. Effective control has been achieved through weekly applications of fungicide beginning when new growth appears and on into mid-July.

Considerable variation in relative disease susceptibility has been observed among the varieties and cultivars of the various hosts. In localities where juniper blight has become a problem, host selections, which show some disease-resistance, should be planted if possible. Although juniper blight is described as a disease of young plants, prolonged cool, wet weather early in the growing season can result in infection of even established plants.

Young shoot tips of mature spruce, fir, and pine that have reached the cone-bearing age may be attacked by the tip blight fungus (*Diplodia pinea*). Plants low in vigor are particularly susceptible. Typical symptoms are wilting or drooping and eventual browning and death of shoots, resembling frost injury. Terminal buds commonly exude resin or pitch and black fungus fruiting bodies appear on dead tissue. Since cones are also attacked and may persist for years with fruiting bodies present, removal of infected cones wherever possible, along with pruning of blighted tips, should decrease the amount of damage. Some reduction in disease damage can be accomplished by spraying susceptible plants, 3 to 5 times at 2-week intervals, with Bordeaux mixture (8-8-100), beginning when new shoots first appear. Trees maintained in a vigorous condition by periodic watering and fertilization are less susceptible to attack by tip blight.

Stem cankers

As evergreens reach maturity they become more sensitive to environmental stresses which can cause weakening and loss of vigor. Such plants are usually more susceptible to attack by insects and disease organisms than younger, more vigorous plants, particularly if they have not received the proper care and maintenance. When plants reach this stage they are often attacked by a group of organisms known as canker fungi. These organisms enter the stem through a break or wound and cause the formation of dead, sunken areas called cankers. In most cases, raised bumps or pustules which are fungus fruiting bodies appear in the canker tissues. Stems attacked by canker fungi may be girdled and the portion of the stem above the canker may die, resulting in dieback and loss of major branches. Since dead branches are not rapidly replaced by new growth on evergreens, the shape of the plant may be altered.

In ornamental plantings, a common disease of weakened spruce and fir is Cytospora canker. Early symptoms appear as browning and defoliation of needles on affected branches. In most cases girdling cankers form, accompanied by the exudation of pitch, and branches die beginning with those nearest the ground and progressing slowly upward. Control may be achieved by pruning out cankered branches and by maintaining plants in a vigorous condition by proper watering and fertilization. Pruning tools should be sterilized between cuts and pruning should be done only during dry weather, since spores of the fungus are readily transferred to healthy tissues under moist conditions. Careful handling to avoid wounding will prevent spread of the disease organism to healthy tissues.

A great many other species of fungi and bacteria may cause canker diseases of evergreens. Symptoms are usually similar to those described for Cytospora canker.

Stem rusts, galls, and witches'-brooms

A group of organisms known as the rust fungi may attack a wide range of evergreen species and result in the formation of canker, stem swellings, galls, or abnormal branch growths called witches'-brooms. All of the rust fungi have one thing in common: they require the presence of two separate host species, one an evergreen and the other a deciduous species, in order to complete their life cycle. Control of this group of fungi on the evergreen hosts, therefore, involves the elimination of the alternate host species or at least separation of the two host species far away from each other.

The formation of witches'-brooms on cedars and other junipers is the result of attack by certain rust fungi of the genus *Gymnosporangium*. Although branches on older trees may be killed and the crowns deformed by witches'-brooms, the occurrence of these growths in landscape plantings is rare and control measures are seldom recommended. The only effective control is the removal of alternate host plants (which are usually ornamental fruit varieties) for a distance of one-half mile or more from the susceptible plants.

A group of closely related fungi of the genus *Cronartium* cause several important stem rusts of pines. Eastern gall rust, which attacks Scots, jack, pitch, and Virginia pines, appears as globose galls or swellings 1 to 2 inches in diameter on affected branches. Often a characteristic distortion or kink of the trunk is formed 3 or 4 feet from the ground. Since the alternate hosts of eastern gall rust are several species of oaks, control is usually impossible.

Comandra rust is widely distributed on ponderosa, Arizona, lodgepole, pitch, mountain, jack, loblolly, Austrian, Scots, and maritime pines. Spindle-shaped swellings are formed on branches and trunks of young trees, but on older trees they may be constricted. Trunk swellings seldom exceed 3½ feet in length. Fortunately the disease is limited by the distribution of the alternate hosts and control measures are seldom warranted.

The most important rust disease of conifers in the United States is white pine blister rust. Losses from this disease have been so severe that federal funds are regularly appropriated for its control. Attack by the fungus produces swollen cankers which may girdle the stems of white pine, causing death of branches or entire trees. Fortunately, blister rust is not known to be of consequence in ornamental plantings because of quarantine regulations against the planting of susceptible currants and gooseberries, which serve as alternate hosts for the fungus. If blister rust does appear, the best control to remove dead and dying branches and to remove or eradicate susceptible currants and gooseberries in the area.

Cedar-apple, cedar-hawthorn, and cedar-quince rust, caused by fungi of the genus *Gymnosporangium*, are the most common stem rusts found in ornamental plantings. The cedar rust fungi invade the needles of susceptible juniper varieties. As the disease progresses, green to brown, globose woody galls are formed by the cedar-apple and cedar-hawthorn rust fungi, and pustules are formed on stems by the cedar-quince rust fungus. Eventually stems may be girdled and the portion of the branch extending outward from the girdle dies. During moist periods in the spring, bright orange, sticky spore horns form on the galls, giving them a striking, weird appearance. When the spore horns dry up, masses of spores are released and may be blown to alternate pomaceous hosts, such as susceptible crab apples and hawthorns, where they cause leaf blight and defoliation. Alternate infection of evergreen and pomaceous hosts is necessary for the cedar-rust fungi to complete their life cycle. Therefore, the best control measure for cedar rusts would be to remove susceptible crabapples and hawthorns in the near vicinity. However, this is seldom feasible, particularly in extensive landscape plantings. Picking or pruning galls before spore horns form will help reduce future infection. Some protection of the juniper hosts can be effected by the application of 3 sprays of ferbam (2 lbs. in 100 gals. water) at 3- to 4-week intervals in July and August Rust-resistant juniper varieties are available and should be planted in areas where cedar rusts are a problem.

Root Diseases

Fortunately, diseases affecting the roots of evergreens do not appear frequently, for once a root disease becomes established, it is usually impossible to save or cure the plant. Control measures must be designed to prevent initial infection. Plants subject to root diseases should be handled carefully during planting or transplanting to prevent root wounding since root rot fungi enter through breaks or wounds. Only disease-resistant species or varieties should be placed in a site which has a history of root infection, since root disease fungi are soil-borne and difficult, if not impossible, to eradicate. Trees low in vigor or with damaged root systems are more subject to root diseases than vigorous specimens. The appearance of stagheading and dieback symptoms on the above-ground parts of a diseased plant indicates that extensive damage has already taken place and it is too late to attempt any effective control. Trees injured by root diseases are easily toppled or uprooted by high winds.

Annosus root rot

The root rot fungus (*Fomes annosus*) is distributed throughout the temperate zones of the world and attacks many coniferous species as well as several hardwoods. Although considered a disease usually confined to forest plantings, annosus root rot may attack ornamental pines, fir, and spruce and cause decay and death. Conks or fruiting bodies of the fungus appear beneath the leaf litter at the base of the affected trees. The fungus passes readily from diseased to healthy trees through root grafts or contacts and may spread through plantings of closely spaced susceptible plants. Since the disease fungus enters through wounds, care to avoid wounding should help prevent initial infection. Treat all fresh wounds and cut stump surfaces with a good wound dressing. Maintain plants in a vigorous condition.

Shoestring root rot

The fungus *Armillaria mellea*, known as the "honey mushroom," is world-wide in distribution and causes rotting of the bark and wood of the roots and root collar of many tree species, including spruces and pines. Affected trees usually die. Species planted outside their natural range and those low in vigor are particularly susceptible to infection. Drought conditions seem to favor the disease. Early symptoms include a general decline followed by abnormal resin flow from the root collar. Black fungus strands resembling shoestrings appear beneath the bark and in the soil surrounding affected trees, and the wood becomes soft and spongy. The only effective control measure is to maintain vigorous trees through periodic watering and fertilization.

Phytophthora root rot

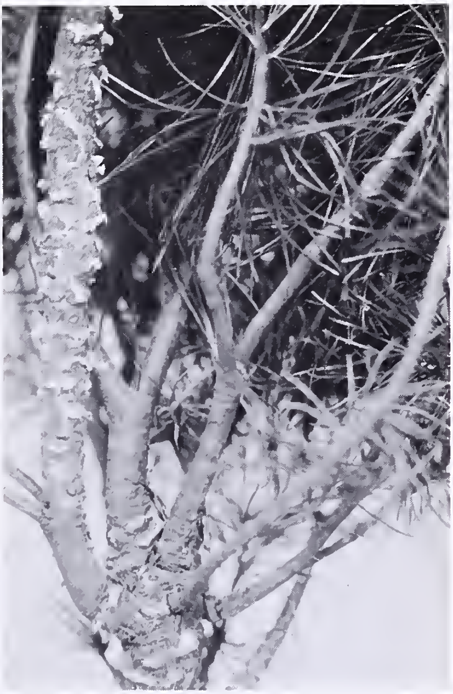
Several species of the fungus *Phytophthora* may attack evergreens, causing root rot, decline, and death of affected plants. These fungi are soil-borne and wide-spread in distribution. One of the most important species, as far as landscape plantings are concerned, causes a root and crown rot of several varieties of yew. Unfortunately, little is known about this disease and control measures have not been developed. Affected plants should be removed and replaced with some other species.

Wood Decays and Rots

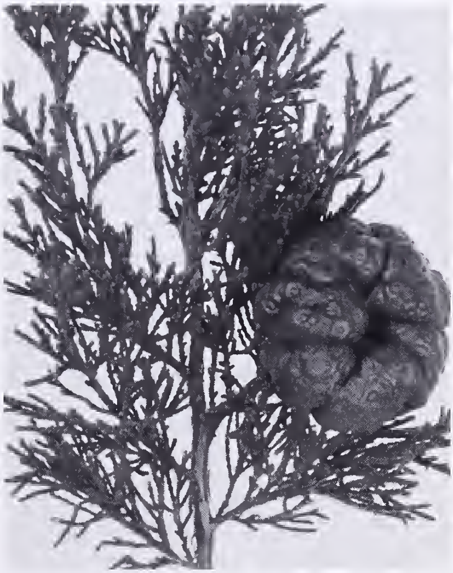
Although evergreens, because of their high resin content, are not generally as susceptible to decay as most hardwood species, old established trees may be attacked by wood decay fungi. Many species of fungi attack wood, some causing a white or soft rot, others a brown or dry rot. In later stages of decay, conks or mushrooms, which are fruiting bodies of the rot and decay fungi, appear on the trunks and branches or arise in the soil from roots of affected trees. Rot and decay fungi are perennial and continue to deteriorate tissues year after year. Affected trees become weakened and are subject to breakage and uprooting during high winds. Since most decay and rot fungi enter through wounds, prevention of wounding and treatment of wounds and pruning scars with wound dressing are recommended control measures. In general, vigorous plants are less subject to injury than those that are weakened or in a state of decline.

Chlorosis

Yellowing or chlorosis of evergreen fol-



Blister rust pustules on branches of the white pine. It can be damaging.



Illinois Natural History Survey

Cedar-apple rust gall on juniper. Alternate hosts are hawthorn and crab.

iage may result from many different causes, but is usually the result of a depletion or lack of some nutrient such as nitrogen or iron in the soil. Periodic fertilization of large specimen plants to replenish the soil nutrient content is a common practice, particularly where a sod cover is present. The addition of iron-containing compounds to the fertilizer may be beneficial in the treatment of chlorosis. Liming of the soil around ornamental plants is not recommended unless the soil is highly acid, since lime may tend to tie up soil nutrients.

Winter drying can be avoided somewhat by mulching sensitive plants and watering until the ground freezes.

A more severe type of injury may occur as a result of a rapid and extensive drop in the temperature. The symptoms of low temperature injury may be similar to winter drying, or they may appear as twig or branch dieback or splitting of bark near the ground line. Another symptom is wilting and death of new shoots during the growing season, as a result of stem injury or girdling which occurred during the winter. ◆

Coniferous Trees for Small Gardens

IN RECENT YEARS, partly because of the limited size of many gardens, there has been a lively interest in small flowering trees, such as dogwoods, crab apples and flowering cherries. Conifers of approximately the same size have not been nearly as popular, but they may often contribute softness, contrast and year-'round interest to the contemporary gardens. Among the best small coniferous trees for such purposes are two pines: the parasol-shaped Japanese or Tanyosho pine *(Pinus densiflora* 'Umbraculifera'), bushy while young and growing slowly to about 12 feet with an open orange-bark trunk; also, the fine-textured Swiss stone pine *(P. cembra),* which is compact and often columnar. It takes many years for this tree to attain even 25 feet. The densely conical umbrella-pine *(Sciadopitys verticillata)* is a very different kind of tree with deep green united needles and an even slower growth rate.

Most full-grown conifers are narrow compared with their height, but some are especially so. Suitable accent trees for many small gardens are the various columnar forms of *Juniperus chinensis, J. scopulorum,* and *J. virginiana.* Although losing their form at maturity, fastigiate Scots and white pines *(P. sylvestris* 'Fastigiata', *P. strobus* 'Fastigiata') may also deserve a place in the garden.

Sargent weeping hemlock *(Tsuga canadensis* 'Pendula') and weeping blue Atlas cedar *(Cedrus atlantica* 'Glauca Pendula'), two low-spreading trees, are among the choicest of their kind for gardens of limited size. Hetz or Pfitzer junipers trained to a single stem and staked for a few years can provide a striking fountain effect.

A few other coniferous trees for the small garden: *Chamaecyparis obtusa* 'Gracilis', *Juniperus chinensis* 'Torulosa', *J. rigida, Picea wilsonii, Pinus peuce, Taxus cuspidata* (upright forms), *Thuja occidentalis* 'Douglasii Pyramidalis', *Tsuga canadensis* 'Atrovirens', *T. c.* 'Compacta', *T. diversifolia* and *T. sieboldii.* All of these trees will grow best in full sun, but the yews *(Taxus),* hemlocks *(Tsuga)* and, to a lesser extent, arbor-vitae *(Thuja)* are shade-tolerant. These three evergreens should be the only coniferous trees selected for shady sites.—*Frederick McGourty, Jr.*

Hundreds of different insects may be found on coniferous evergreens

INSECT ENEMIES OF CONIFERS

Donald L. Schuder

FORTUNATELY only a few of the insects which are found on conifers are destructive. Many are actually beneficial and are an essential part of the "balance of nature." A few of the more common destructive insects include bark beetles, ambrosia beetles, tip moths, scale insects, sawflies, and weevils. (See also the check list of insect pests, and the specific conifers which they attack, at the end of this article.)

Pest problems can be lessened and even sometimes prevented from occurring by selecting trees for planting from a group that is the least susceptible to attack. For instance, pines, spruces, firs, and hemlocks are susceptible to insect depredation (in the order named), while metasequoia, cryptomeria, cedar, cypress, larch, and redwood have few insect problems and probably none that would threaten the existence of the mature tree. Therefore, if a choice is possible, it is advisable to select a tree from the latter group.

Again, when a choice is possible, it is sensible to avoid planting trees which are already extensively used in your area. Pine trees (which until recent years here in Indiana were relatively pest free) have been widely planted for such diverse purposes as landscaping, forestation, conservation, and cutting for the Christmas-tree market. In any region where one kind of conifer—and often one species such as the Scots pine—as been set out in extensive acreages, the balance of nature tends to be upset and there can result a rapid buildup of destructive insect pests. Therefore, many pine pests may already exist in the area—ready to attack any newly planted pine trees.

If you do select a species subject to insect attack, you should be prepared to spray the tree to prevent damage. Healthy trees suffer less from insect attack than do weak trees. Plant the new tree properly on a good site and in the correct hardiness range. Keep it in a healthy condition by fertilization and watering. However, it should not be given too much nitrogenous fertilizer as experiments have shown that trees which are soft and succulent from excess amounts of nitrogen, are susceptible to heavy infestations of mites.

Avoid mass plantings of a single species: mixed plantings usually suffer less damage. Avoid planting spruce and Douglas-fir trees in the same area since they are alternate hosts for the Cooley spruce gall aphid. (Spraying suggestions given below are timed for temperate-climate regions. In warmer areas, sprays must be applied earlier.)

Bark Beetles and Ambrosia Beetles

Bark beetles and ambrosia beetles usually attack trees that have been injured, or are otherwise in low vigor. The burrows of the adult insects appear on the trunks of trees as small shot holes. The insects are small, cylindrical and are brown to black. The larvae which exist beneath the bark are small, soft, yellowish-white grubs. Each kind of bark beetle produces a characteristic tunnel in the surface of the wood beneath the bark by which it may be identified. Increasing tree vigor by fertilization and watering is the best preventive. Applications of lindane are helpful in reducing the population. Heavily infested trees should be removed and burned to reduce the hazard to nearby trees.

Ants and Termites

In some regions, large, black, carpenter ants and white termites establish colonies in the dead heartwood of coniferous trees, weakening them so that they will be easily blown over. The Alleghany mound ant has been known to kill trees within several feet of its nest by biting the tissue and injecting formic acid into the wound.

Ants can also be troublesome on coniferous trees by infesting them with various species of aphids (see below), which the ants tend as "cows" for the honeydew that they produce. In the South, the Texas leafcutting ant damages young pines by stripping leaves, buds and bark. Ants and termites may be controlled by treating the trunk and surrounding soil with chlordane. Injecting the insecticidal solution into the soil with a soil lance or mixing it with the soil by means of a high pressure spray gun will usually kill the colony.

Aphids

Aphids, particularly those of the genus *Cinara,* are common pests of coniferous trees. They are tended by ants. The aphids will not kill the trees but their continuous removal of plant sap reduces the vigor of the host. A further problem develops because of the black sooty mold, which grows in the sweet, sticky honeydew secreted by the aphids. The black mold makes the foliage unsightly and also mars objects beneath the tree. Aphid infestations may be readily controlled by applying malathion, diazinon or lindane to the tree in accordance with the manufacturer's directions. Systemic insecticides, such as Cygon and Di-Syston, are also effective, but should be applied in the soil for maximum effectiveness. Controlling ant colonies, as suggested above usually reduces aphid problems.

The Bagworm

Bagworms are easily recognized because of the silken, spindle-shaped bags which the caterpillars construct around themselves for protection. The caterpillars feed voraciously on many conifers from mid-May to mid-August and frequently cause the death of the tree by defoliating the plant. If the trees are small and the infestation light, bagworms can be controlled by hand picking, but large trees with heavy infestations should be sprayed. Spray early in the season, as the insects are easiest to control at that time. Malathion or diazinon, used according to the manufacturer's directions, will control bagworms.

Bark Weevils

Several weevils of the genera *Pissodes* and *Hylobius* feed on the terminals and lateral branches of conifers. Usually the branch dies beyond the point at which feeding occurs. The larval stage of most species occurs in stumps where excelsior-covered "chip cocoons" are formed. Bark weevils are seldom of serious importance on ornamental plantings.

Galls

Galls are abnormal growths on plants. On conifers they are usually caused by chermids and midges. The presence of these insects induces the plant to grow unusual structures which serve as protection for the pests. There are many kinds of galls, each characteristic of the organism which causes it.

Some of the more common galls are cypress flower gall, cypress leaf gall, cypress twig gall, eastern spruce gall, Cooley's spruce gall. While the galls may be conspicuous and may disfigure the foliage and twigs, they do not seriously affect the health and vigor of the host.

The Cooley spruce gall (*Chermes cooleyi* Gillette) occurs wherever spruces are commonly grown. It infests Colorado blue, Engelmann, Sitka and Oriental spruces. Douglas-fir is an alternate host, although no galls are produced on the fir. The female insect overwinters at the base of the needles of the spruce and in the spring lays eggs in white masses of cottony wax. The nymphs, upon hatching, move out on the new growth to feed. Their feeding induces the formation of a cone-like gall about 2½ inches in length at the tip of the new growth. The gall has multiple chambers which house the nymphal chermids. About the first of July the galls open and the insect migrates to Douglas-fir. The following spring the insect migrates back to spruce. However, the alternation of hosts is not essential and the insect can persist on either host. The gall can be prevented by pruning off and destroying the galls before they open and by spraying the foliage in early spring or late fall with malathion, lindane, diazinon or Sevin, according to the manufacturer's directions. Dormant sprays of lime sulfur, diluted one to nine with water, are also helpful.

Black Vine Weevil and Strawberry Root Weevil

The black vine weevil (*Brachyrhinus sulcatus*) is a serious pest of yews, but it also attacks retinospora and hemlocks as well as many broad-leaved evergreens. The adult black weevil is about 3/8 inch long and seldom seen as it feeds at night. The adults will notch the margins of leaves. When yews fail to grow and the foliage loses color, often times the roots will have been eaten by the larvae. They are whitish, curved grubs, about 3/8 of an inch in length, with brown heads. The larvae mature in May and as adults are found in June and July, usually hiding under the clods of soil and debris beneath the tree. The insect can be controlled by spraying the base of the plant and the soil with dieldrin or chlordane or incorporating 5 per cent chlordane dust into the soil according to the manufacturer's recommendations. Treatments are best applied in June when adults are starting to emerge and a soil treatment will be effective for several years.

The damaging strawberry root weevil (*Brachyrhinus ovatus*) is a pest of hemlock, arbor-vitae, yew and some kinds of spruce and juniper. It is similar in appearance to the black vine weevil but smaller in size. The larvae feed on the roots of hemlock and often kill the plant; on arbor-vitae, the tree is seldom killed, but the adults often kill twigs and consume the foliage. The same controls suggested for the black vine weevil will control the strawberry root weevil, but the material should be applied in the middle of May.

Bud Moths and Bud Worms

The spruce budworm (*Choristoneura fumiferana*) is one of the most destructive insect pests of conifers and its range includes all areas where they are grown.

How the Hicks Nursery, now the oldest surviving nursery on Long Island, once delivered conifers on Jericho Turnpike. (Compare with the photographs on pages 56 and 57!)

Its host plants include Douglas-fir, spruces, pine, hemlock, and larch. When the cyclic populations are high, entire trees are stripped of their foliage, while under less population pressure the terminals may be killed. In the spring, when new growth begins, the larvae mine in the needles and buds and feed on the staminate flowers and pollen. Later the larvae web together the tips of the new growth; feeding occurs mainly along the side of the new growth with the larvae feeding on the leaf bases. Thus, this insect destroys many more needles than it consumes. Damage can be prevented by spraying in the late fall or early spring with malathion in accordance with the manufacturer's directions.

The Deodar Weevil

The deodar weevil (*Pissodes nemorensis*) eats small round holes through the cambium of Atlas, Lebanon and Deodar cedars as well as weakened Scots and white pines. The feeding often girdles leaders and side branches. The white, brown-headed grubs tunnel beneath the bark, girdling terminals and laterals, which often die about the first of the year. The brownish adult has white scales on its back and is about 1/3 of an inch in length. The adult weevils feed in the early spring and fall. Keep the trees, particularly pines, in a healthy condition by fertilization and watering, and spray when necessary with DDT. When using DDT, it is advisable to add a miticide to the spray to prevent a build up of mites.

Eucosma gloriola

Pinkish to dirty-white larvae tunnel in the pith areas of terminal and lateral branches of white, Scots, red, and Austrian pine and rarely on Douglas-fir in the Northeast. The infested shoots wilt, die and often break off in the wind. Pruning and burning wilting terminals helps prevent the problem. No insecticidal control is known.

European Pine Shoot Moth

The larval stage of the European pine shoot moth (*Rhyacionia buoliana*) is a serious pest of red, Scots, mugho, and Austrian pines. The small, tan larvae, which have black heads, overwinter in the buds and move to other buds in the spring. In heavy infestations all terminal growth is killed; in lighter infestations crooked terminals develop. The damage of the insect decreases when treees become large. Control on small trees can be accomplished by pruning out and burning infested terminals prior to mid-May. Specimens that are sheared can be kept clean by shearing in early July and throwing the trimmings on the ground where the small larvae perish. Pine trees can be protected by spraying with malathion, Sevin or Guthion in mid-April or mid-June, and repeating the spray in ten days. Granular applications of systemic insecticides such as dimethoate, Di-Syston and phorate appear promising. Follow the manufacturer's recommendations for rate of application.

Flatheaded Borers

The adult beetle stage of the flatheaded borers of the family Buprestidae are beautifully marked and metallic-colored, and are attracted to the sunny side of trees in May, June and July. They may be seen running up and down the trunk on bright days. The larval stages of several species tunnel beneath the bark of living trees, particularly those that have been weakened by injury, transplanting, drought, and other causes. While there are many species which could cause problems on conifers, only a few of the most important can be discussed here.

The flatheaded bald-cypress sapwood borer (*Acmaedora pulchella*) occurs in the Eastern and Southern states. It bores in cypress and related species, usually attacking wounded and weakened trees. The larvae tunnel beneath the bark and later completely riddle the sapwood.

In the South the flatheaded bald-cypress heartwood borer (*Trachykele lecontei*) attacks weakened and dying bald-cypress. The greater part of their mines are in the heartwood.

The hemlock borer (*Melanophila fulvoguttata*) attacks ailing hemlock and

Giant-sequoia or "big tree" in Calaveras Grove (California); 280 feet high and 93 feet in girth. (From William Robinson's *Flora and Sylva*, Vol. II, 1902).

spruce. Trees that have been weakened by injury, defoliation, and transplanting are the most susceptible. The larvae tunnel beneath the bark, separating it from the wood with their wide, shallow galleries. Trees in parks and estates are often killed by this species.

Control of flatheaded borers consists of keeping the trees healthy with proper horticultural practices—spraying, watering, and fertilizing as needed. Prune off and burn infested branches and fatally injured trees. Trees weakened by injury and transplanting should have their trunks sprayed with endosulfan (Thiodan) during May, June and July when the adult beetles are depositing their eggs. Wrapping the trunk of the trees with commercial borer paper or burlap is also helpful. If the tree is wrapped, use only dust or wettable powder formulations of the insecticides on the trunk in order to prevent oil injury beneath the wrapping.

Scale Insects

As a group, the scale insects are among the most destructive pests of conifers. These insects have hypodermic-needle-like mouthparts with which they remove the plant sap, thereby weakening the plant. They occur in large numbers, completely covering the branches, twigs, and foliage. Heavy infestations can kill all or part of the host plant.

The scale insects are divided into two groups: the hard or armored scales and the soft or lecanium scales. The armored scales, unlike the soft scales, are covered with a shell of protective wax, usually hard and separable from the body. The armored scales are mobile only in the crawler stage, but the soft scales may retain some mobility and move about the plant to a slight extent. As an example, they may go from the leaves to the twigs in the fall.

Scale insects can be controlled during the dormant period by applying sprays of dormant oil or lime sulfur. The crawler stages of the armored scales can be controlled with properly timed sprays of malathion, or systemic insecticides such as dimethoate (Cygon). The soft scales are amenable to control with sprays of malathion, or Sevin (carbaryl) timed to coincide with the emergence of the crawlers.

Armored Scales

Black pine leaf scale (*Aspidiotus californicus*) is widely distributed over North America on pine, but is also reported to infest Douglas-fir, hemlock, and other conifers. It is especially serious on young trees, which it often kills. The mature scales are circular, 1/16 inch in diameter, yellow-brown to black. The insect has one to three generations per season depending upon the locality. It overwinters as a partly grown scale.

Fiorinia hemlock scale (*Fiorinia externa*) infests hemlock, yew, and spruce in the Eastern United States. Infested plants have a whitewashed appearance due to the large numbers of insects on the underside of the needles. The foliage turns yellow and may drop. The female is yellowish but stays inside of her cast skin and thus appears white. In the North there are two generations while farther south reproduction is continuous. The systemic insecticide dimethoate appears to be particularly effective against this species.

Hemlock scale (*Aspidiotus ithacae*) a widely distributed species, circular in outline and black in color, occurs in great numbers on the underside of the needles of hemlock, Douglas-fir and several species of pine. Young trees can be killed from attacks by this pest.

Juniper scale (*Diaspis carueli*) appears as small, dirty-white, circular scales with yellow nipples and causes the foliage of junipers, arbor-vitae, incense cedar, and cypress to look unhealthy. Crawlers hatch in early June.

Pine needle scale (*Phenacaspis pinifoliae*) is a common pest of pines and spruce, but also of hemlock, fir, and incense cedar in the Eastern United States. The female scale is like a white tear drop and about 1/10 inch in length. The male is smaller and is white with four parallel ridges. Infested needles turn yellow and the entire plant becomes unthrifty. The insect winters as purplish, bean-shaped eggs under the female scale. Crawlers are present in late May and the third week of July.

Soft Scales

Fletcher's scale (*Lecanium fletcheri*) is a common pest of yew, arbor-vitae, and junipers. Tan-colored, cup-shaped scales infest twigs and underside of needles. The scales secrete copious quantities of sticky honeydew in which a black sooty mold often grows. The insect overwinters as a partially grown nymph which matures in the spring. The adult deposits hundreds of eggs in late May and June, which hatch in late June and early July. Insecticide applications should be made in mid- to late June, or in early May.

Pine tortoise scale (*Toumeyella numismaticum*) causes defoliation, dwarfing, and death of young trees. The oval, reddish-brown female scales cluster on twigs causing heavy honeydew accumulations with accompanying black sooty mold. A related species (*T. pini*) infests mugho, lodge pole and Scots pines in the Eastern United States.

The spruce bud scale (*Physokermes piceae*) is especially common on Norway spruce but is also found on other species. Round, and gall-like reddish-brown scales cluster at the base of branchlets and closely resemble buds, so are difficult to detect. Honeydew accumulations furnish a medium for the growth of sooty mold which attracts bees and flies. Young crawlers hatch in July. There is only one generation a season.

Some Other Pests

The spruce epizeuxis (*Epizeuxis aenula*) is a common pest of spruce trees in the Northeastern United States. Small, brown larvae web and feed on older needles. There is an accumulation of sawdust-like frass in the webbing. Brownish gray moths emerge in June and July. The insect over-winters as a partially grown larva in the webbing. Malathion sprays in the early spring and late fall give control.

White pine weevil, *Pissodes strobi,* is a severe pest of pine and spruce in the Eastern United States. The terminal leader on the tree wilts, turns brown, and often develops into what resembles a shepherd's crook. The injured terminal is replaced by lateral branches which give the tree a double leader, or a crooked leader. The adult weevil, seldom seen as it is nocturnal in habit, is reddish-brown, about 1/4 inch long, and has a white hash mark on each wing cover. In May and June the weevil lays its eggs on the terminal and the grubs feed, head downward, beneath the bark. They sometimes tunnel for a distance of one to three whorls. They pupate in excelsior-lined pits beneath the bark. Infested terminals should be pruned out and destroyed prior to mid-June. Terminals may be protected by spraying in mid-April with lindane or 4.5 ounces of malathion (57% E.C.) per gallon of water.

The Zimmerman pine moth (*Dioryctria zimmermani*) infestations can be detected by the presence of white resin masses near the whorls. The first symptoms are usually wilting and browning of new growth. Later the larvae leave the pith area tunnel around the whorl areas. The insect seems to be attracted to injured areas, and infested trees are attacked repeatedly. The insect attacks all pines and Douglas-fir, primarily in the northern tier of states.

Trees with infested whorls and branches should be removed and burned prior to August. Sprays of Guthion or lindane are applied in mid-April and again in mid-August for control. The spring application will probably also control the European pine shoot moth, European pine sawfly, and leafrollers as well as the Zimmerman pine moth. Thus one application serves to control several important pine pests

Gypsy Moth

The gypsy moth (*Porthetria dispar*) is a serious pest in the Northeastern United States. The mature brown hairy caterpillars with five pairs of blue tubercles (dots) and six pairs of red tubercles along the back are about 2 inches long. While most common on deciduous trees, they are serious defoliators of hemlock, cedar, pine, and spruce. The larvae are nocturnal feeders during June and July. Ornamental plants may be protected by applying Sevin (carbaryl) as suggested on the manufacturer's label.

Hemlock Looper

The hemlock looper (*Lambdina fiscellaria*) is an inch worm, yellowish green to gray in color, with a row of two black dots down its back. In the Eastern United States, it defoliates hemlock, spruce, pine, and balsam fir. Damage usually starts in the top of the tree and the larvae drop downward on silken threads. Control consists of an application of malathion used according to the manufacturer's suggestions. Another related species (*L. athasaria*) attacks ornamental hemlocks. The 1½-inch larva is yellowish with dark markings.

Mealybugs

Mealybugs are related to the scale insects and suck plant juices from the host. They are soft-bodied and covered with white flocculent wax. The body is fringed with long tassels of wax. The eggs are deposited in a white wax sac at leaf axils or among dead needles. The cypress, grape, and taxus mealybug are pests of needled evergreens out-of-doors. The densely sheared species are usually most heavily infested by mealybugs. Control sprays should be applied early in the season and applied with enough pressure to penetrate and cover all parts of the plant. Malathion diluted according to the directions on the container gives excellent control.

Mites and Needle and Leaf Miners

Conifers are widely infested by spider mites, the most common species being the spruce spider mite (*Oligonychus ununguis*), which feeds on the needles of Sitka spruce, firs, pines, larch, arbor-vitae, and junipers. The mites puncture the surface of the needles causing them to turn brown and drop. The infestation usually starts at the bottom of the plant and works upward, thus defoliation follows the same directional sequence. This mite overwinters in the egg stage and the eggs hatch very early in the warm spring sunshine immediately beginning to feed. Heavily infested plants may be severely cobwebbed. Since mites are small and barely visible to the naked eye, they can often be found by shaking the plant over a white piece of paper. The mites can then be seen as very small, mobile black spots.

Control by applying miticides to ornamentals before serious damage occurs and repeat as needed. Some of the commonly available materials include dicofol (Kelthane), Ovotran, Acaraben (Chlorobenzilate) and Morestan. Systemic insecticides, such as Meta-Systox-R, are also effective against mite populations out-of-doors. Always follow the manufacturer's directions.

Several species of leaf miners tunnel in the needles of coniferous evergreens such as arbor-vitae, pine, and spruce. Their mining causes the needles to turn brown and the trees become very unsightly.

The arbor-vitae leaf miner (*Argyresthia thuiella*) causes the tips of the leaves to turn brown, due to the feeding within the leaf by a small maggot, which overwinters in the leaves. In May and June a tiny gray moth with a 1/3-inch wingspread emerges from the needles.

The pine needle miner (*Exoteleia pinifoliella*) is occasionally abundant in the Eastern States. A small brown larva mines from the tip to the base of the needle causing the injured needles to turn yellow and finally brown.

The spruce leaf miner (*Taniva albolineana*) attacks blue, Norway, Engelmann and Sitka spruces in both the East and the West. Light greenish larvae web the needles together and burrow inside the needles. The entire foliage of small trees may become webbed; on large trees the lower foliage is most severely damaged.

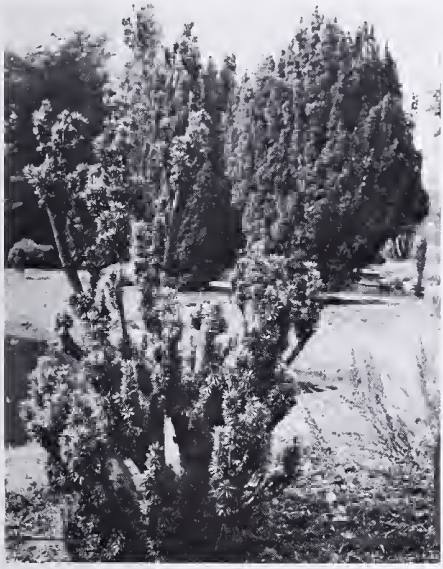
Leaf miners may be controlled by applying either methoxychlor or malathion in mid-May and repeating the spray in mid-June.

Pine Tube Moth

Greenish-yellow larvae, with brown heads, web together several needles and eat off the distal end. When not feeding, the "worms" hide inside the tube, where they also overwinter as pupae. In the Eastern U. S., they attack white pine, while in the Rocky Mountain region of the West they attack lodgepole and whitebark pines. While they will not kill a tree, they make the host quite unsightly. On a small plant the insect can be controlled by collecting and burning the tubes during the winter; large trees should be sprayed with TDE (Rhothane), Sevin, Guthion or malathion as suggested by the manufacturer for the control of leaf rollers, to which the pine tube moth is related.

Pine Webworm

The pine webworm (*Tetralopha robustella*) produces globular masses of brown frass at the ends of terminals and laterals of young red, Scots, white, pitch, jack, and loblolly pines. The yellowish-brown larvae, with lateral black stripes, feed on the needles in the webbed mass of frass. Hand picking the webbed needles is probably the easiest method of control. To prevent damage, spray the tree with malathion.



Pruning can be important in shaping of conifers. *Taxus baccata* 'Fastigiata' can be sharply pruned. Pruned plant, front, was same size as plant in rear. (Arboretum Trompenberg, Rotterdam).

Roundheaded Borers and Longhorned Beetles

Most species bore in wood, but several species attack living trees. The white or yellowish larvae have a bulbous enlargement just behind their heads. When small, the larvae tunnel beneath the bark; later they tunnel into the wood and produce large quantities of sawdust-like frass which they often push from their tunnels. Their tunneling often kills the trees or so weakens the trees they do not kill that they become subject to windthrow. The nocturnal adults usually lay their eggs on weakened trees, therefore it behooves the owner to keep the trees healthy and vigorous by proper watering and fertilization.

Sawflies

Sawfly larvae resemble caterpillars, but they have more than five pairs of fleshy prolegs. Most sawfly larvae live exposed on the plant and feed in colonies, especially when young. Several species are important defoliators of conifers.

The Abbott's or white pine sawfly (*Neodiprion pinetum*) is white with a black head and has four rows of black spots on the body. The insect prefers white pine, but will also feed on red, mugo, pitch, and short-leaf pines. The sawflies feed on both old and new foliage, and when abundant will strip the trees. There are two generations each season and larvae are present in May and August. Light infestations can be controlled by pruning off and burning the colony, however heavy infestations may require spraying with lead arsenate.

The European pine sawfly (*Neodiprion sertifer*) is a serious defoliator of most commonly grown species of pine. The larvae hatch in late April and eat the old needles from the tree before the new growth develops. The larvae are grayish green with gray and black stripes and black heads. There is one generation per year. Control consists of applying carbaryl or malathion a virus disease which attacks and controls only this species of sawfly.

White, red, black, and Norway spruces are attacked by the European spruce sawfly (*Diprion hercyniae*). Defoliated trees usually die. The larvae are green with five narrow white stripes. There are two or three broods per season. Spray ornamentals with carbaryl (Sevin).

Red-headed or Leconte's pine sawfly. (*Neodiprion lecontei*) is yellowish-white with a reddish brown head and six rows of black spots running the length of the body. The larvae feed in colonies and prefer old foliage, but late in the season may eat new needles and the tender bark of young twigs. There are two overlapping generations with larvae present from May until late fall. The host list includes most pines, larch and deodar cedar. Spray foliage with lead arsenate.

The yellow-headed spruce sawfly (*Pikonema alaskensis*) attacks white, red, black, Norway, Colorado blue and Engelmann spruces. It prefers new foliage until the larvae are about half grown. Eggs are laid in May and June and hatch in about a week into yellow-green, gray-green striped larvae with brown heads. They feed for about a month. There is only a single generation per season. Control consists of timely applications of carbaryl or malathion.

SELECTED CONIFERS AND THEIR INSECT PESTS

Abies amabilis (Cascade Fir)

- Balsam twig aphid, *Minardus abietinus*
- Bagworm, *Thyridopteryx ephemeraeformis*
- Balsam fir sawfly, *Neodiprion abietis*
- Hemlock looper, *Lambdina fiscellaria*
- Scales:
  - Oystershell scale, *Lepidosaphes ulmi*
  - Pine needle scale, *Phenacaspis pinifoliae*
- Spotted tussock moth, *Halisidota maculata*
- Spruce mite, *Oligonychus ununguis*
- Zimmerman pine moth, *Dioryctria zimmermani*

Abies concolor (White or Silver Fir)

- Ambrosia beetles:
  - *Gnathotrichus aciculata*
  - " *denticulatus*
  - " *sulcatus*
  - *Platypus wilsoni*
- Aphid, *Cinara curvipes*
- Bark beetles:
  - *Hylurgops lecontei*
  - *Hylastes gracilis*
  - *Pseudohylesinus grandis*
  - " *granulatus*
  - Firengraver, *Scolytus ventralis*
- Bark weevil, *Pissodes piperi*
- Bud moths:
  - Spruce budworm, *Choristoneura fumiferana*
  - *Dichelonyx testaceipennis*
  - *Tricolepis inornata*
  - *Zeiraphera griseana*
- Carpenter ant, *Campanotus* spp.
- Cone moth, *Dioryctria abietella*
- Flatheaded borers:
  - *Buprestis rusticorum*
  - Sculptured pine borer, *Chalcophora angulicollis*
  - *Chrysobothris dolata*
  - " *pseudotsugae*
  - *Dicera tenebrosa*
  - *Trachykele nimbosa*
- Horntails:
  - *Urocerus californicus*
  - *Sirex juvencus*
  - *Xeris morrisoni*
- Leaf feeders:
  - *Galenara consimilis*
  - Spotted tussock moth, *Halisidota argentata*
  - *Hemerocampa oslari*
  - Douglas-fir tussock moth, *Hemerocampa pseudosugata*
- White fir needle miner, *Epinotia mertana*
- Roundheaded borers:
  - *Chrysobothris placida*
  - *Neoclytus muricatulus*
  - *Phymatodes hardyi*
  - *Peliaenus oregonus*
  - *Leptostylus nebulosus*
  - *Semanotus litigiosa*
  - *Tetropium abietus*
- Sawyers:
  - Oregon fir sawyer, *Monochamus oregonensis*
  - Lion beetle, *Ulochaetes leoninus*

Abies lasiocarpa (Rocky Mountain or Alpine Fir)

- Ambrosia beetles:

  Gnathotrichus sulcatus
  Platypus wilsoni
  Trypodendron ponderosae
Aphids, *Cinara curvipes*
Bark beetles:
  Crypturgus borealis
  Dryocoetus confusus
  Pseudohylesinus grandis
  Scolytus ventralis
Bark weevils:
  Pissodes burkei
  " *piperi*
Bud moths:
  Acleris variana
  Spruce budworm, *Choristoneura fumiferana*
Caterpillar, *Lambdina fiscellaria lugubrosa*
Flatheaded borers:
  Buprestis rusticorum
  Chrysophana placida
  Melanophila drummondi
Pitch nodule moth, *Petrova piciolana*
Roundheaded borers:
  Monochamus oregonensis
  Phymatodes dimidiatus
  Poliaenus oregonus

Abies procera (A. nobilis) **(Noble Fir)**

Ambrosia beetles:
  Gnathotrichus sulcatus
  Platypus wilsoni
Bark beetle, *Pseudohylesinus nobilis*
Chermid, *Chermes piceae*
Cone moth, *Dioryctria abietella*
Flatheaded fir borer, *Melanophila drummondi*
Roundheaded borer, *Poliaenus oregonus*
Twig beetle, *Pityophthorus pseudotsugae*

Araucaria heterophylla (excelsa) **(Norfolk Island Pine)**

Mealybugs:
  Golden mealybug, *Pseudococcus aurilanatus*
  Citrus mealybug, *Planococcus citri*
  Cypress mealybug, *Pseudoeoccus ryani*
Scales:
  Erioeoccus araucariae
  Chrysomphalus rossi
  Chaff scale, *Paralatoria pergardii*
  Florida red scale, *Chrysomphalus aonidum*
  Soft brown scale, *Coccus hesperidum*
Greenhouse thrips, *Heliothrips haemorrhoidalis*

Calocedrus (Libocedrus) decurrens

Ambrosia beetle, *Xyleborinus libocedri*
Carpenter ants, *Campanotus* spp.
Bark beetle, Western cedar bark beetle, *Phloeosinus punctatus*
Flatheaded borers:
  Trachykele blondeli
  " *opulenta*
Cypress mealybug, *Pseudococcus ryani*
Mites:
  Oligonychus spp.
  Tetranychus spp.
Roundheaded borers:
  Atimia dorsalis
  Blazed tree borer, *Serropalpus barbatus*
  Callidium californicum
  Phymatodes nitidus
  Semanotus amethystinus
  " *ligneus amplus*
Scales:
  Bark scale, *Ehrhornia cupressi*
  Diaspidiotus ehrhornia
  Juniper scale, *Diaspis carueli*
  Xylococculus macrocarpae
Tip moths:
  Argyresthia arceuthobiella
  " *libocedrella*
Twig beetles:
  Phloeosinus antennatus
  " *fulgens*
  " *Hoppingi*
  " *randykei*
  " *punctatus*

Cedrus atlantica **'Glauca' (Atlas or Algerian Cedar)**

Bow-legged fir aphid, *Cinara curvipes*
Bark beetles:
  Cedar bark beetle, *Phloesinus cupressi*
  Western cedar bark beetle, *P. punctatus*
Deodar weevil, *Pissodes nemorensis*
Mealybugs:
  Grape mealybug, *Pseudoccus maritimus*
  Juniper mealybug, *Pseudococcus juniperi*
  Taxus mealybug, *Pseudococcus wisteriae*
Sawflies:
  Cedar cone sawfly, *Augomonoctenus libocedri*
  Red-headed pine sawfly, *Neodiprion lecontei*
Scales:
  Black scale, *Saissetia oleae*
  Cottony-cushion scale, *Icerya purchasi*
  Florida red scale, *Chysomphalus aonidum*
  Florida wax scale, *Ceroplastes floridensis*
  Newstead's scale, *Lepidosaphes newsteadi*
  Pine needle scale, *Phenacaspis pinifoliae*
  Pine scales, *Matsucoccus* spp.
  Soft brown scale, *Coccus hesperidum*
  Western horntail, *Sirex areolatus*

(Continued)

Cedrus deodora (Deodar Cedar)

Bark beetle, *Pityophthorus pulicarius*
Red-headed pine sawfly, *Neodiprion lecontei*
Weevil, Deodar Weevil, *Pissodes nemorensis*

Cedrus libani (Cedar of Lebanon)

Deodar weevil, *Pissodes nemorensis*

Chamaecyparis lawsoniana (Lawson-cypress)

- Flatheaded borers:
    - Cypress sapwood and heartwood borer, *Trachykele lecontei*
- Gall:
    - Cypress flower gall, *Itonida anthici*
    - Cypress twig gall, *Itonida taxodii*
- Leaf feeder:
    - Bagworm, *Thyridopteryx ephemeraeformis*
- Roundheaded borers:
    - Cypress bark borer, *Physocnemum andreae*
    - Cypress and Cedar borers, *Oeme* spp.

Chamaecyparis obtusa (Hinoki-cypress)

Bagworm, *Thyridopteryx ephemeraeformis*

Chamaecyparis pisifera (Sawara-cypress)

Bagworm, *Thyridopteryx ephemeraeformis*

Cupressus arizonica (Arizona Cypress)

- Cypress aphid, *Siphonatrophia cupressi*
- Flatheaded borer, *Chyrsobothris texana*
- Leaf feeder:
    - White-marked tussock moth, *Hemerocampa leucostigma*
- Cypress mealybug, *Pseudococcus ryani*
- Roundheaded borer, *Atimia huachucae*
- Bark scale, *Ehrhornia cupressi*

Ginkgo biloba (Ginkgo, Maidenhair Tree)

- Leaf feeders:
    - Omnivorous looper, *Sabulodes caberata*
    - White-marked tussock moth, *Hemerocampa leucostigma*
    - Grape mealybug, *Pseudococcus maritimis*

Juniperus chinensis (Chinese Juniper) and others

- Red-cedar aphid, *Cinara sabinae*
- Red-cedar bark beetle, *Phloesinus dentatus*
- Leaf feeders:
    - Bagworm, *Thyridopteryx ephemeraeformis*
    - Juniper midge, *Contarinia juniperina*
    - Juniper webworm, *Dichomeris marginella*
- Mites:
    - Red spider mite, *Tetranychus urticae*
    - Spruce mite, *Oligonychus ununguis*
- Scales:
    - Juniper scale, *Diapis carueli*
    - Utah cedar scale, *Aonidia shastae*

Picea breweriana (Siskiyou or Brewer's Spruce)

- Ambrosia beetles:
    - *Gnathotrichus sulcatus*
    - *Trypodendron bivitattum*
    - " *borealis*
    - " *ponderosa*
- Aphids:
    - Balsam twig aphid, *Mindarus abietinus*
    - Pine leaf aphid, *Pineus pinifoliae*
- Bark beetles:
    - *Crypturgus borealis*
    - Alaska spruce beetle, *Dendroctonus borealis*
    - Engelmann spruce beetle, *Dendroctonus engelmanni*
    - *Dolurgus pumilus*
    - *Dryocoetus affaber*
    - *Dryocoetus confusus*
    - *Hylastes macer*
    - *Hylurgops rugipennis*
    - *Ips dubius*
    - " *engelmanni*
    - " *interpunctus*
    - " *pilifrons*
    - " *tridens*
    - *Orthotomicus vicinus*
    - *Polygraphus rufipennis*
    - *Scierus annectons*
    - Spruce scolytus, *Scolytus piceae*
- Bark weevil, *Pissodes coloradensis*
- Bud moths:
    - *Acleris variana*

- Spruce budworm, *Choristoneura fumiferana*
- *Zeiraphera griseana*
- " *ratzeburgiania*

Caterpillar, *Galenara consimilis*

Chemids:
- *Chermes cooleyi*
- *Pineus boycei*
- " *pinifoliae*
- " *similis*

Loopers:
- Western hemlock looper, *Lambdina fiscellaria lugubrosa*
- File hemlock looper, *Nepytia canosaria*
- Phantom hemlock looper, *Nepytia phantasmaria*

***Picea engelmannii* (Engelmann Spruce)**

Flatheaded borer:
- *Dicerca tenebrosa*
- *Melanophila drummondi*

Blazed tree borer, *Serrapalpus barbatus*

Leaf feeders:
- Spruce epizeuxis, *Epizeuxis aenula*

Roundheaded borer, *Xylotrechus undulatus*

Yellow-headed spruce sawfly, *Pikonema alaskensis*

Spruce bud scale, *Physokermes piceae*

Twig beetles:
- *Pityophthorus pseudotsugae*
- " *nitidulus*
- " *tuberculatus*

Twig moth, *Eucosoma sonomana*

Twig weevils:
- *Magdalis alutacea*
- *Pissodes engelmanii*
- White pine weevil, *Pissodes strobi*

***Picea glauca* (White Spruce)**

Eastern spruce gall aphid, *Chermes abietis*

Spruce budworm, *Choristoneura fumiferana*

Sawflies:
- European spruce sawfly, *Diprion hercyniae*
- Yellow-headed spruce sawfly, *Pikonema alaskensis*

White pine weevil, *Pissodes strobi*

***Picea pungens* (Colorado Spruce**

Ambrosia beetles:
- *Gnathotrichus sulcatus*
- *Trypodendron bivittatum*

Bark beetles:
- Engelman spruce beetle, *Dendroctonus engelmanii*
- *Dryocoetus affaber*
- *Polygraphus rufipennis*

Chermids:
- *Pineus pinifoliae*
- " *similis*

Flatheaded borer, *Buprestis aurulenta*

Leaf feeders:
- Bagworm, *Thyridopteryx ephemeraeformis*
- Gypsy moth, *Porthetria dispar*

Needle miners:
- *Recurvaria piceaella*

(*Continued*)

How to Train a New Terminal

ONE OF THE occasional irritations in growing conifers is the unexpected die-back of the terminal (main) shoot or leader. In the Northeast the dead leader occurs most often on white pine *(Pinus strobus),* a beautiful tree which is susceptible to a weevil *(Pissodes strobi)* that bores its way into the vital terminal shoot to lay its eggs in spring. The grubs hatch in a week's time and feed on the inner bark, girdling the stem and thus killing it. When the terminal shoot of a young tree dies or is eaten away by deer, often two or more side branches will grow upward and the tree will develop several branch trunks as time goes by. Frequently, these may be architecturally attractive, but they are not for all gardens.

If a single upright trunk is desired, here is a way to train a new terminal shoot: cut off the dead terminal shoot as soon as observed. Choose the strongest of several side shoots and wrap Number 12 insulated copper wire firmly around it, gently bending the shoot to an upright position. Continue the wire wrapping down the main trunk for about 15 inches. Re-wrap as needed the second year. Result: a new terminal shoot.—*Frederick McGourty, Jr.*

    - Spruce needle miner, *Taniva albolineana*
- Strawberry root weevil, *Brachyrhinus ovatus*

***Picea sitchensis* (Sitka Spruce)**

- Ambrosia beetles:
    - *Gnathotrichus sulcatus*
    - *Trypodendron bivitattum*
    - “ *cavifrons*
- Aphids:
    - *Neomyzaphis abietina*
    - Pine leaf aphid, *Pineus pinifoliae*
- Bark beetles:
    - *Crypturgus borealis*
    - *Dendroctonus obesus*
    - *Dolurgus pumilus*
    - *Dryocoetes affaber*
    - *Hylurgops rugipennis*
    - *Ips concinnus*
    - “ *interruptus*
    - “ *tridens*
    - “ *vancouveri*
    - *Polygraphus rufipennis*
    - *Pseudohylesinus sitchensis*
- Bud moths
    - *Acleris variana*
    - Spruce budworm, *Choristoneura fumiferana*
- Spruce needle miner, *Taniva albolineana*
- Pitch nodule moths:
    - *Petrova burkeana*
    - *Vespamima novaraensis*
- Roundheaded borers:
    - *Asemum atrum*
    - *Leptura obliterata*
    - *Opsimus quadralineatus*
    - *Tetropium velutinum*
- Twig beetle, *Pityophthorus nitidulus*
- Twig weevils:
    - *Pissodes costatus*
    - “ *sitchensis*

***Pinus aristata* (Hickory Pine, Bristlecone Pine)**

- Bark beetle, *Pityophthorus* spp.
- Twig beetle, *Dendroctonus ponderosae*

***Pinus jeffreyi* (Jeffrey's Pine)**

- Ambrosia beetles:
    - *Gnathotrichus retusus*
    - *Xyleborus scopulorum*
- Bark beetles:
    - *Dendroctonus jeffreyi*
    - “ *valens*
    - “ *macer*
    - *Hylurgops porosus*
    - “ *subcostulalis*
    - *Ips confusus*
    - “ *emarginatus*
    - “ *latidens*
    - “ *oregoni*
    - *Orthotomicus ornatus*
    - *Pityogenes carinulatus*
    - *Pityophthorus confertus*
    - “ *confinus*
    - “ *tuberculatus*
- Chermids, *Pineus coloradensis*
- Flatheaded borers:
    - *Anthaxia aeneogaster*
    - *Buprestis aurulenta*
    - “ *connexa*
    - “ *nutalli laeviventris*
    - *Chalcophora angulicollis*
    - *Chrysobothris californica*
    - “ *caurina*
    - “ *dentipes*
    - “ *monticola*
    - “ *semisculpta*
    - *Chrysophana placida*
    - *Dicera sexualis*
    - “ *tenebrosa*
    - *Melanophila californica*
    - “ *gentilis*
- Horntails:
    - *Sirex aerolatus*
    - “ *californicus*
- Leaf beetle, *Dicheloynx crotchi*
- Leaf feeder, *Coloradia pandora*
- Leaf miner, *Recurvaria milleri*
- Leaf weevils:
    - *Scythropus albidus*
    - “ *californicus*
    - “ *ferrugineus*
- Mite, *Phytoptus pini*
- Roundheaded borers:
    - *Acanthocinus obliquus*
    - “ *spectabilis*
    - *Asemum atrum*
    - “ *makelumne*
    - “ *nitidum*
    - *Ergates spiculatus*
    - *Monochamus maculosus*
    - *Phymatodes hirtellus*
    - *Ulachaetes leoninus*
- Scales:
    - *Matucoccus bisetosus*
    - “ *fasciculensis*
    - *Nucalaspis californica*
    - Pine needle scale, *Phenacaspis pinifoliae*
- Twig moths:
    - *Cylindrocopturus eatoni*
    - *Magdalis cuneiformis*
    - “ *gentilis*
    - “ *lecontei*
    - *Pissodes yosemite*
- Twig weevils:
    - *Dioryctria abietella*
    - “ *xanthoenobares*

  - *Eucosoma bobana*
  - *Laspeyresia piperana*

Pinus lambertiana (Sugar Pine)

- Ambrosia beetles:
  - *Gnathotrichus retusus*
  - " *sulcatus*
- Bark beetles:
  - *Dendroctonus monticolae*
  - " *valens*
  - *Hylastes gracilis*
  - " *macer*
  - *Hylurgops porosus*
- Spruce budworm, *Choristoneura fumiferana*
- Chermid, *Pineus coloradensis*
- Flatheaded borers:
  - *Anthaxia aeneogaster*
  - *Buprestis aurulenta*
  - " *nuttalli laeviventris*
  - *Chalcophora angulicollis*
  - *Chrysobothris semisculpta*
  - *Chrysophana placida*
  - *Melanophila gentilis*
- Horntails:
  - *Sirex aerolatus*
  - *Sirex behrensis*
- Roundheaded borers:
  - *Acanthocinus spectabilis*
  - *Callidium antennatum hesperum*
  - *Monochamus maculosus*
  - *Spondylis upiformis*
  - *Ulochaetus leoninus*
- Sawfly, *Neodiprion edwardsii*
- Scales:
  - *Metsucoccus paucicicatrices*
  - *Nuculaspis californica*
  - Pine needle scale, *Phenacaspis pinifoliae*
  - *Pityococcus ferrisi*
- Twig beetles:
  - *Pityophthorus confertus*
  - " *confinis*
  - " *tuberculatus*
- Twig moth, *Dioryctria abietella*
- Twig weevils:
  - *Magdalis lecontei*
  - *Pissodes californicus*
  - *Pissodes yosemite*

Pinus mugo (Mugo Pine)

- European pine shoot moth, *Rhyacionia buoliana*
- Sawflies:
  - Abbott's pine sawfly, *Neodiprion pinetum*
  - European pine sawfly, *Neodiprion sertifer*
- Zimmerman pine twig moth, *Dioryctria zimmermani*

Pinus nigra (Austrian Pine)

- Pine bark aphid, *Pineus strobi*
- Moths:
  - European pine shoot moth, *Rhyacionia buoliana*
  - Zimmerman pine moth, *Dioryctria zimmermani*
- Scales:
  - Pine needle scale, *Phenacaspis pinifoliae*
  - Pine tortoise scale, *Toumeyella numismaticum*
- Pine root collar weevil, *Hylobius radicis*

Pinus palustris (Long-leaf Pine)

- Bark beetles:
  - Southern pine beetle, *Dendroctonus frontalis*
  - *Pityophthorus comatus*
  - " *plagiatus*
- Turpentine borer, *Buprestis apricans*
- Red-headed pine sawfly, *Neodiprion lecontei*

Pinus resinosa (Red or Norway Pine)

- Allegheny mound ant, *Formica exsectoides*
- Bark beetles:
  - *Ips chagnoni*
  - *Pityophthorus* spp.
- Spruce budworm, *Archips fumiferana*
- Moths:
  - *Battaristis vittella*
  - European pine shoot moth, *Rhyacionia buoliana*
  - *Lambdina athasaria pellucidaria*
  - *Olene palgiata*
  - *Rhyacionia rigidana*
  - Zimmerman pine moth, *Dioryctria zimmermani*
- Sawflies:
  - *Diprion frutetorum*
  - European pine sawfly, *Neodiprion sertifer*
  - *Neodiprion dyari*
  - " *eximina*
  - Red-headed pine sawfly, *Neodiprion lecontei*
  - Red pine sawfly, *Neodiprion nanulus*
  - White pine sawfly, *Neodiprion pinetum*
- Pine needle scale, *Phenacaspis pinifoliae*
- Spittlebugs:
  - Pine spittlebug, *Aphrophora parallela*
  - Saratoga spittlebug, *Aphrophora saratogensis*
- Webworms:
  - Nesting pine sawfly, *Acantholyda zappei*
  - Pine false webworm, *Acantholyda erythrocephala*
  - Pine webworm, *Tetralopha robustella*

(Continued)

Fast-growing Conifers

RAPID-GROWING trees, while often popular with new-home owners, are not often choice subjects. In the case of many shade trees, they are usually weak-wooded and prone to storm damage. Fortunately, though, there are several good conifers which are fast-growing yet sturdy trees. Metasequoias were planted near the replica of the Ryoanji Temple Stone Garden at the Brooklyn Botanic Garden in 1963 to screen nearby apartment houses. Already sizable specimens then, these deciduous conifers continue to grow 3 feet a year and are now approaching 40 feet. In a milder climate their growth would be even greater.

Leyland-cypress (*Cupressocyparis leylandii*), an evergreen hybrid, may be even faster-growing than metasequoia. A good example of this hybrid tree's vigor occurs at Cambridge University Botanic Garden in England. One specimen there is twice the size of the parent species, *Cupressus macrocarpa* and *Chamaecyparis nootkatensis*, though planted the same year. Mr. Joseph Witt of the University of Washington Arboretum reports that *Cupressocyparis* planted at the Arboretum in 1950 was 35 feet tall in 1969.

Other conifers which, in a favorable climate and with good soil conditions, can be expected to grow 2-3 feet or more at a certain stage of their development are *Picea abies, P. pungens, P. sitchensis, Pinus ponderosa, P. strobus, Pseudotsuga menziesii* and *Thuja plicata*.

—Frederick McGourty, Jr.

Weevils:
  Pales weevil, *Hylobius pales*
  Pine gall weevil, *Podapion gallicola*
  Pine root collar weevil, *Hylobius radicis*
  Pissodes approximatus
  White pine weevil, *Pissodes strobi*

Pinus sabiniana **(Digger Pine)**

Bark beetles:
  Dendroctonus valens
  Ips confusus
  “ *latidens*
  “ *oregoni*
  “ *ponderosae*
Bud mite, *Phytoptus pini*
Flatheaded borers:
  Anthaxia aeneogaster
  Buprestis aurulenta
  “ *nutalli laeviventris*
  Chrysophana placida
  Melanophila californica
Pitch nodule moth, *Petrova sabiniana*
Leaf weevil, *Scythropus californicus*
Roundheaded borer, *Asemum nitidum*
Scales:
  Matsucoccus fasciculensis
  Nucalaspis californica
  Pine needle scale, *Phenacaspis pinifoliae*
Twig beetle, *Pityophthorus tuberculatus*

Pinus strobus **(White Pine)**

Aphids:
  Pine bark aphid, *Pineus strobi*
  White pine aphid, *Cinara strobi*
Bark beetles:
  Pityogenes hopkinsi
  Pityophthorus cariniceps
  “ *cognatus*
  “ *consimilis*
  “ *opaculus*
  “ *puberulus*
  “ *pulicarius*
  “ *pullus*
Moths:
  Eucosma gloriola
  Pine tube moth, *Argyrotaenia pinatubana*
  Zimmerman pine moth, *Dioryctria zimmermani*
Pine needle scale, *Phenacaspis pinifoliae*
Pine spittlebug *Aphrophora parallela*

Pinus wallichiana (griffithii) **(Himalayan Pine)**

White pine weevil, *Pissodes strobi*

Podocarpus nagi **(Makino)**

Scales:
  California red, *Aonidiella aurantii*
  Dictyospermum scale, *Chrysomphalus dictyospermi*

- Florida red scale, *Chrysomphalus aonidum*
- Florida wax scale, *Ceroplastes floridensis*
- Glover scale, *Lepidosaphes gloverii*
- Japanese wax scale, *Ceroplastes ceriferus*
- Latana scale, *Aspidiotus lataniae*
- Long soft scale, *Coccus elongatus*
- Purple scale, *Lepidosaphes beckii*

Pseudotsuga menziesii (Douglas-fir)

- Ambrosia beetles:
  - *Gnathotrichus aciculatus*
  - " *retusus*
  - " *sulcatus*
  - *Platypus wilsoni*
  - *Trypodendron bivitattum*
  - " *cavifrons*
  - " *ponderosae*
- Aphids:
  - Douglas fir, *Cinara pseudotaxifoliae*
  - Monterey pine aphid, *Essigella californica*
- Bark beetles:
  - *Crypturgus borealis*
  - *Dendroctonus pseudotsugae*
  - " *valens*
  - *Dryocoetus affaber*
  - " *pseudotsugae*
  - *Hylastes minutus*
  - " *nigrinus*
  - " *ruber*
  - *Polygraphus rufipennis*
  - *Pseudohylesinus grandis*
  - " *nebulosus*
  - *Scolytus fiskei*
  - " *monticolae*
  - " *reflexus*
  - " *tsugae*
  - " *unispinosus*
- Bark moth, *Laspeyresia laricana*
- Borers:
  - Blazed tree borer, *Serropalpus barbatus*
  - Cedar tree borer, *Semanotus ligneus*
- Bud moths:
  - *Acleris variana*
  - Spruce budworm, *Choristoneura fumiferana*
  - *Zeiraphera griseana*
- Chermids:
  - Cooley spruce gall, *Chermes cooley*
- Flatheaded borers:
  - *Anthaxia aeneogaster*
  - *Buprestis adjecta*
  - " *aurulenta*
  - " *langi*
  - " *nuttalli*
  - " " *laeviventris*
  - " *ruticorum*
  - *Chalcophora angulicollis*
  - *Chrysobothris breviloba*
  - " *carinipennis*
  - " *dolata*
  - " *pseudotsugae*
  - " *sylvania*
  - *Chrysophana placida*
  - *Dicerca crassicollis*
  - " *sexualis*
  - " *tenebrosa*
- Horntails:
  - *Sirex behensii*
  - *Xeris morrisonii*
  - *Xeris spectrum*
- Leaf beetles, *Dichelonyx testaceipennis*
- Loopers:
  - Phantom hemlock looper, *Nepytia phantasmaria*
  - Western hemlock looper, *Lambdina fiscellaria lugubrosa*
- Midges:
  - Balsam gall midge, *Cecidomyia balsamicola*
  - Douglas-fir cone midge, *Contarinia oregonensis*
- Moths:
  - Douglas-fir cone moth, *Barbara colfaxiana*
  - Douglas-fir tussock moth, *Hemerocampa pseudotsugata*
  - Pine cone moth, *Dioryctria abietella*
  - Silver-spotted tiger moth, *Halisidota argentata*
  - Zimmerman pine moth, *Dioryctria zimmermani*
  - Pine butterfly, *Neophasia menapia*
- Pitch moths:
  - Douglas-fir pitch moth, *Vespamima novarroensis*
  - Sequoia pitch moth, *Vespamima sequoiae*
- Roundheaded borers:
  - *Arhopalpus productus*
  - *Asemum atrum*
  - *Callidium pseudotsugae*
  - " *vancouverense*
  - *Ergates spiculatus*
  - *Leptora obliterata*
  - *Megasemum asperum*
  - " *obtusus*
  - " *oregonensis*

Sequoiadendron giganteum (Big Tree)

- Ambrosia beetle, *Gnathotrichus sulcatus*
- Bark beetle, *Phloesinus rubicundulus*
- Flatheaded borer, *Trachykele opulenta*
- Roundheaded borer:
  - *Callidium sequarium*
  - *Phymatodes nitidus*
  - *Semanotus ligneus amplus*
- Scale, *Cryptaspidiotus shastae*

(Continued)

Taxodium distichum **(Bald-cypress)**

- Ambrosia beetle, *Platypus compositus*
- Bark beetles:
  - Southern cypress bark beetle, *Phloesinus taxodii*
  - *Micrasis opacicollis*
  - *Tomolips quercicola*
- Flatheaded borers:
  - Flatheaded bald-cypress heartwood borer, *Trachykele lecontei*
  - Flatheaded bald-cypress sapwood borer, *Acmaeodora pulchella*
- Gall insects:
  - Cypress flowering gall, *Itonida anthici*
  - Cypress leaf gall, *Itonida taxodii*
  - Cypress seed midge, *Retinodiplosis taxodii*
  - Cypress twig gall, *Thecodiplosis ananassi*
- Leaf beetle, *Phyllophagi taxodii*
- Leaf feeders:
  - Bagworm, *Thyridopteryx ephemeraeformis*
- Roundheaded borers:
  - Cypress bark borer, *Physocnemum andreae*
  - Ivory-marked beetle, *Eburia quardigeminata*
  - *Oeme rigida*
- Juniper scale, *Diaspis carueli*
- Webworm:
  - Cypress moth, *Recurvaria apicitripunctella*

Taxus cuspidata **(Japanese Yew)**

- Ants and Termites:
  - Carpenter ants, *Campanotus* spp.
  - Subterranean termite, *Reticulitermes flavipes*
- Asiatic garden beetle, *Maladera (Autoserica) castanea*
- Chermids:
  - Cooley's spruce gall aphid, *Chermes cooleyi*
- Flatheaded borers:
  - *Buprestis aurulenta*
  - *Melanophila drummondi*
- Leaf feeders:
  - *Halisidota argentata*
  - *Lambdina fiscellaria lugubrosa*
  - *Nephytia plantasmaria*
- Mealybugs:
  - Grape mealybug, *Pseudococcos maritimus*
  - Taxus mealybug, *Pseudococcus wisteriae*
- Scales:
  - Cottony taxus scale, *Pulvinaria floccifera*
  - California red scale, *Aonidiella aurantii*
  - Dictyospermum scale, *Chrysomphalus dictyospermi*
  - Fletcher scale, *Lecanium fletcheri*
  - Oleander scale, *Aspidiotus hederae*
  - Pine needle scale, *Phenacaspis pinifoliae*
  - Purple scale, *Lepidosaphes beckii*
- Weevils:
  - Strawberry root weevil, *Brachyrhinus ovatus*
  - Black vine weevil, *Brachyrhinus sulcatus*

Thuja occidentalis **(Arbor-vitae)**

- Arbor-vitae aphid, *Cinara tujafilina*
- Caterpillars:
  - Bagworms, *Thyridopteryx ephemeraeformis*
  - Hemlock looper, *Lambdina fiscellaria*
- Bark beetles:
  - Northern cedar bark beetle, *Phloesinus canadensis*
  - Western cedar bark beetle, *Phloesinus punctatus*
- Arbor-vitae leaf miner, *Argyresthia thuiella*
- Cypress mealybug, *Pseudococcus ryani*
- Mites:
  - Red spider, *Tetranychus urticae*
  - Spruce mite, *Oligonychus ununguis*
  - Tip-dwarf mite, *Eriophyes thujae*
- Sawfly:
  - Arbor-vitae sawfly, *Monoctenus melliceps*
- Scales:
  - Dictospermum scale, *Chrysomphalus dictyospermi*
  - European fruit lecanium, *Lecanium corni*
  - Fletcher scale, *Lecanium fletcheri*
  - Glover scale, *Lepidosaphes gloverii*
  - Juniper scale, *Diaspis carueli*
  - Latana scale, *Aspidiotus lataniae*
  - Newstead's scale, *Lepidosaphes newsteadi*
  - San José scale, *Aspidiotus perniciosus*
- Weevils:
  - Arbor-vitae weevil, *Phyllobius intrusus*
  - Lilac weevil, *Brachyrhinus neridionalis*
  - Strawberry root weevil, *Brachyrhinus ovatus*

Thuja orientalis **(Oriental Arbor-vitae)**

Probably many of the same pests as *T. occidentalis*

Tsuga canadensis **(Canadian Hemlock)**

- Ambrosia beetles:
  - *Gnathotrichus retusus*
  - " *sulcatus*
  - *Platypus wilsoni*
  - *Trypodendron bivitattum*
  - " *cavifrons*
  - " *ponderosae*
  - *Xyleborinus tsugae*
- Carpenter ants, *Campanotus* spp.
- Bark beetles:
  - *Dendroctonus pseudotsugae*
  - *Hylastes nigrinus*

  - *Hylurgops rugipennis*
  - *Pseudohylesinus tsugae*
  - *Scoltyus tsugae*
- Bud moths:
  - Black-headed budworm, *Acleris variana*
  - Spruce budworm, *Choristoneura fumiferana*
- Caterpillars:
  - Bagworm, *Thyridopteryx ephemeraeformis*
  - Gypsy moth, *Porthetria dispar*
- Flatheaded borers:
  - *Chrysobothris caurina*
  - *Chrysophana placida*
  - *Melanophila drummondi*
  - " *fulvoguttata*
  - Spotted hemlock borer, *Trachykele nimbosa*
- Leafminers:
  - *Epinotia nanana*
  - Spruce needle leafminer, *Taniva albolineana*
- Loopers:
  - False hemlock looper, *Nepytia canosaria*
  - Hemlock looper, *Lambdina fiscellaria*
  - Phantom hemlock looper, *Nepytia phantasmaria*
  - Western hemlock looper, *Lambdina fiscellaria lugubrosa*
- Mites:
  - Red spider, two-spotted mite, *Tetranychus urticae*
  - Spruce mite, *Oligonychus ununguis*
- Roundheaded borers:
  - *Opsimus quadrilineatus*
  - *Phymatodes dimidiatus*
  - *Poliaenus oregonnus*
  - *Tetropium velutinum*
  - *Xylotrechus undulatus*
- Hemlock sawfly, *Neodiprion tsugae*
- Twig beetle, *Pityophthorus* spp.
- Weevils:
  - *Cylindrocopturus* sp.
  - Sapwood weevil, *Rhyncolos* spp.
  - Strawberry root weevil, *Brachyrhinus ovatus*
- Scales:
  - Black pine leaf scale, *Aspidiotus californicus*
  - Cottony-cushion scale, *Icerya purchasi*
  - Florida wax scale, *Ceroplastes floridensis*
  - Grape scale, *Aspidiotus uvae*
  - Hemlock scale, *Apsidiotus ithacae*
  - Hemlock fiorina, *Fiorina externa*
  - Latania scale, *Aspidiotus lataniae*
  - Lesser snow scale, *Pinnaspis strachani*
  - Pine needle scale, *Phenacaspis pinifoliae*
  - Red bay scale, *Chrysomphalus perseae*

Tsuga caroliniana (Carolina Hemlock)

Most of the same pests listed for *T. canadensis.*

Tsuga mertensiana (Mountain Hemlock)

Many of the same pests listed for *T. canadensis.*

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New Conifers for American Gardens

MOST OF THE important ornamental conifer species were introduced to America before World War I in a golden era of plant exploration, but this does not mean that the day of the plant hunter is over. Today is the age of the cultivar, and many introductions in recent years have consisted of selected forms of well-known species. In some cases conifers introduced many years ago had only a precarious toe-hold in American horticulture.

Thanks to the New Crops Research Branch of the U. S. Department of Agriculture, which has had a joint program of introduction with Longwood Gardens since 1956, many new plants have been made available to botanic gardens and nurserymen, who are propagating the most promising of them. The best will gradually be making their way to retail nurseries and thence to private gardens. Due to the efforts of contemporary plant hunters like Dr. John L. Creech, Chief of the New Crops Research Branch, and Dr. Richard W. Lighty of Longwood Gardens, there have lately been introductions or re-introductions of *Cunninghamia konishii, Keteleeria davidiana, Pinus koraiensis, Taiwania cryptomerioides* and *Thuja koraiensis,* among others.—*Frederick McGourty, Jr.*

BOOKS ABOUT CONIFERS

Frederick McGourty, Jr.

MANY BOOKS have been written about conifers over the years. For those who desire more extensive information than can be provided in this Handbook, here are a few of the most important works.

The best of recent years: William Dallimore and A. Bruce Jackson, *A Handbook on Coniferae and Ginkgoaceae,* revised by S. G. Harrison (New York: St. Martin's Press, 1967, 729 pp.). It is a comprehensive account written by English botanists and is specially useful for identification purposes. The emphasis is on conifers for British conditions, with attention to silviculture, but there is also much solid information for Americans.

P. Den Ouden and B. K. Boom's *Manual of Cultivated Conifers* (The Hague: Martinus Nijhoff, 1965, 526 pp.) is the most extensive treatment of cultivars to be published. The first writer was a well-known Dutch nurseryman with intimate knowledge of the vast range of these plants, and a great amount of research clearly went into the history of particular garden forms. When his health failed, the book was completed by Dr. Boom, a Wageningen (Netherlands) horticultural taxonomist. The lack of a good English editor is apparent throughout the book, and many of the cultivars mentioned are of little consequence for all but the most avid collector. Still, these are fairly minor quibbles with a valuable work that will be on the reference table for years to come.

Cornell Professor Liberty Hyde Bailey was responsible for more than 67 books. One that stood the test of time rather well is his compilation, *The Cultivated Conifers* (New York: The Macmillan Company, 1933, 285 pp.). There is sound growing advice by several writers, and Alfred Rehder's influence on the taxonomic aspects is noteworthy. The book is a revision of *The Cultivated Evergreens* (1923), which was based in large part on many of the articles written for Bailey's *Standard Cyclopedia of Horticulture.*

Slow-growing forms have received much attention in recent years, and while somewhat out of the scope of this Handbook, H. J. Welch's *Dwarf Conifers: A Complete Guide* (Newton, Massachusetts: Charles T. Branford Company, 1966, 344 pp.) deserves special mention for its clear close-up photographs, which are a help in the identification of many cultivars in a difficult plant group. The book is a witty and refreshing account by an English hobbyist but hardly a "complete guide."

A short but substantial paperback is Harold G. Hillier's *Dwarf Conifers* (London: Alpine Garden Society & Scottish Rock Garden Club, 1964, 83 pp.). Mr. Hillier, one of the great nurserymen of the era, approaches his subject with many years of experience.

All books on dwarf forms must be compared with Murray Hornibrook's *Dwarf and Slow-growing Conifers,* revised edition (London: Country Life, Ltd., 1938, 286 pp.). While slightly dated because of nomenclature changes and because of the existence of a number of new cultivars, it contains much information that cannot be found elsewhere.

Two secondary accounts should be mentioned—they are intended for a general gardener—James H. Beale's *The Evergreens* (Garden City: Doubleday & Company, Inc., 1960, 285 pp.) and L. L. Kumlien's *The Friendly Evergreens* (Dundee, Illinois; D. Hill Nursery Company, 1946). The last book, sponsored by one of America's largest wholesale dealers in conifers, is profusely illustrated.

Several books are historical landmarks of sorts, available only in botanical libraries but well worth the collector's effort to seek out. One of the finest of 19th-century British conifer works is Aylmer Bourke Lambert's *A Description of the Genus Pinus,* 2 volumes, 1832, which underwent several editions. Among the remarkable color plates are drawings of Menzies' leaf specimen of the redwood (*Sequoia sempervirens*) (identified as *Taxodium sempervirens*) and Rimu (*Dacrydium cupressinum*), a specimen of which was brought to England from New Zealand on one of Captain Cook's voyages in the late 18th century. The work is by a son of the Enlightenment; one can even find a recipe—borrowed from the French—for spruce beer. (Long-leaf pine detail, right, is from it.)

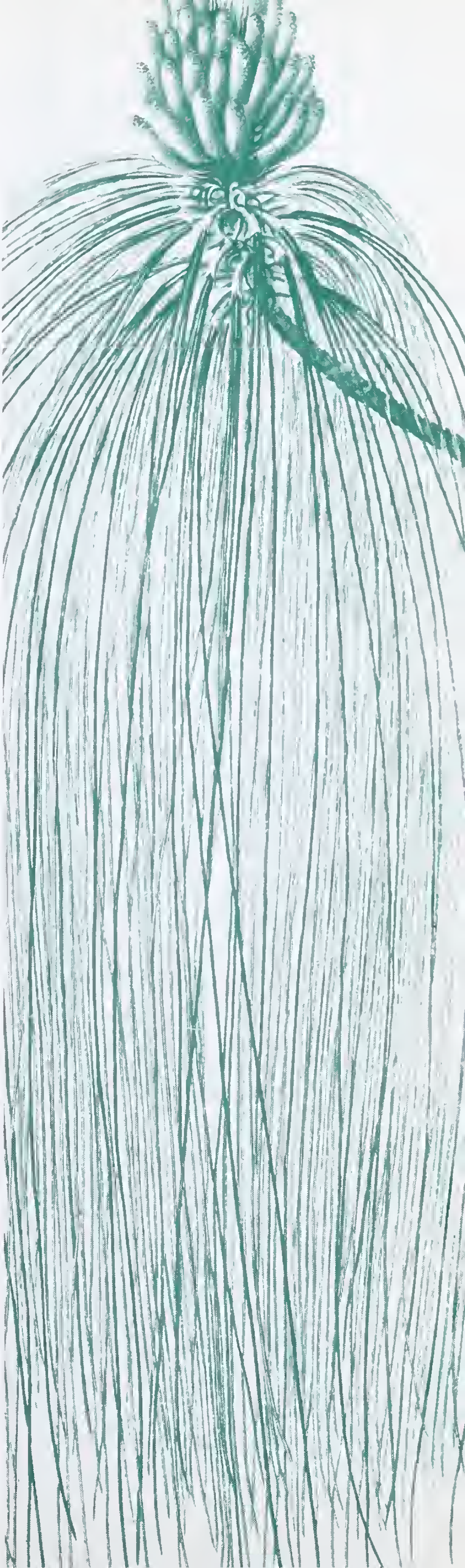
The first American book on conifers was Josiah Hoopes' *The Book of Evergreens* (New York: Orange Judd & Co., 1868, 435 pp.). It gives a fine account of the then-new conifers in the American nursery trade; also of a few collectors of the day. Hoopes was a West Chester, Pennsylvania nurseryman.

Henry Winthrop Sargent's *Supplement* to Andrew Jackson Downing's *A Treatise on the Theory and Practice of Landscape Gardening*, 7th edition (New York: Orange Judd & Co., 1865, pp. 427-573) is one of the most significant reports written on conifers in America.

Ernest Henry Wilson's *The Conifers and Taxads of Japan* (Cambridge: Harvard University Press, 1916, 91 pp.) gives a good idea of some of the discoveries by Westerners in Japan in the early part of the 20th century.

A conifer enthusiast should not overlook the wonderful descriptions in volumes 10-12 and 14 of Charles Sprague Sargent's *The Silva of North America* (Boston & New York: Houghton Mifflin & Co., 1819-1902). While the late Victorian literary era is apparent in Sargent's depiction of trees he was especially fond of, it actually contributes to this landmark work by one of America's great botanists. Sargent knew his conifers well, and one regrets that few latter-day botanists share the love of plants *in their entirety* that was Sargent's.

Finally, a book for the keen collector of pines—N. T. Mirov's *The Genus Pinus* (New York: The Ronald Press Company, 1967, 602 pp.). While meant primarily for the botanist, it offers much to serious amateurs desiring a wider knowledge of this important genus. ◆



Notes and buying information on

125 CONIFERS

Frederick McGourty, Jr.

THE FOLLOWING LIST includes most of the important conifers which are available in the retail nursery trade. Dwarf conifers, with a few exceptions, are not included. The emphasis in the compilation that follows is on species and taller-growing horticultural forms. A list of firms selling dwarf conifers may be obtained from the Brooklyn Botanic Garden upon request by sending a stamped, self-addressed envelope. Also available—a list of pre-bonsai nurseries, which often carry unusual conifers.

A word about ordering conifers by mail: Most mail-orders firms ship only small sizes. Unless there is a special need, it is uneconomical and often risky to ship trees in the 2- to 3-foot-and-over range, as such specimens must be balled and burlapped. Large trees can often be picked up at local nurseries, and when really large specimens are desired, it is well to have them moved and planted by the nursery.

From Zone 6 northward spring delivery is best for young conifers, which require special care until they become established. The main danger to small plants is in drying out. They are best planted in a home nursery area, where they can be regularly watered and mulched for the first few years, and then transplanted to a permanent position. All conifers, whatever their size, should enter freezing weather well-watered.

If planted in the autumn, specimens in the New York area and similar regions may be safely put in between early September and late October, watered regularly until the ground freezes and mulched well. In colder areas a light shade cover of protective boughs should be provided for young plants. Even normally hardy conifers may die in winter unless this protection is given.

KEY: (*) denotes a tree on Guest Editor Teuscher's selection of the "50 Finest Conifers" on page 4. Numbers in parenthesis following the plant name refer to the hardiness zones on the Arnold Arboretum map (inside back cover). Letters following the description of a tree are coded nursery sources—see the end of this list. A code letter followed by "-s" indicates a seed listing.

European silver fir *(Abies alba)* (4). Of historical interest as the first exotic fir grown in Colonial America, this tree grows wild in the mountains of Central Europe. Once commonly planted, but few good specimens are found in gardens of the eastern U.S. today. B, CR, SF, CR-s, FA-s, ME-s, SC-s, TM-s.

*Cascade fir *(Abies amabilis)* (5). When Scotsman David Douglas found this tree growing in the Cascade Mountains of Oregon, just south of the Columbia River, on the same day in 1825 he discovered the noble fir (*A. procera*), he said they were "two of the noblest species of the tribe." Most firs are mountain trees. They usually require cool, moist air to perform their best in gardens. B, CR, SF, CR-s, G-s, SC-s.

Balsam fir *(Abies balsamea)* (3). A tree of the North Woods, the fragrant balsam is usually satisfactory only in its native range (and occasionally short-lived in cultivation even there). A popular Christmas tree and attractive particularly when young—as all firs are. SR, G, ME, MU, SF, VI, CR-s, FA-s, SC-s.

Greek fir *(Abies cephalonica)* (5). Native to the higher mountains of Greece. This fir was introduced into American gardens before the middle of the 19th century, but has not been widely planted. A fine specimen may be seen at the Bayard Cutting Arboretum, Oakdale, Long Island. The Cutting Arboretum has one of the best conifer collections in the eastern U.S. B, CR, G, SF, CR-s, FA-s, SC-s.

*White fir *(Abies concolor)* (4). A popular and variable fir with a wide natural distribution in the American West. Discovered by journeyman-botanist August Fendler (1813-1883) near Santa Fe, New Mexico in 1847. It is better adapted to dry climates than most other firs. B, CR, EF, ES, G, ME, MU, SF, SH, W, CR-s, FA-s, ME-s, SC-s.

Fraser fir *(Abies fraseri)* (4). Native to the highest parts of the southern Appalachian Mountains, this Southern counterpart of the balsam fir is somewhat better suited to moderate-climate gardens than the balsam. It is generally unsatisfactory in the New York City area. This usually small tree is named for its discoverer, English traveler John Fraser (1750-1811), who introduced it to Britain. CR, ME, MU, SF, W, CR-s, FA-s, G-s, ME-s, SC-s.

Vancouver fir *(Abies grandis)* (6). One of Douglas' discoveries near the Columbia River (1825). This tall-growing fir, native from Vancouver Island to northern California, is more successful in England, where humidity is often high, than in the eastern U.S. Mr. Edward C. Childs, owner of Great Mountain Forest, Norfolk, Connecticut, reports that Vancouver fir has been satisfactory in the cool Berkshire foothills. B, CR, SF, CR-s, FA-s, G-s, SC-s.

*Nikko fir *(Abies homolepis)* (4). German-born botanist Philipp Franz von Siebold (1796-1866), who spent many years in plant exploration in Japan, introduced this tree to Western (Holland) cultivation in 1859. A common fir of the mountains of central Japan. More satisfactory in the eastern U.S. than most other firs. A, B. G, RA, SF, CR-s, FA-s, G-s, ME-s, SC-s.

Korean fir *(Abies koreana)* (5.) A small fir (perhaps to 50 feet) compared with the giant firs of the Pacific Northwest. Native to the mountains of South Korea. Seldom grown in American gardens, but worthy of further planting because of its short, bright green needles. In its dwarf form 'Prostrata', it is one of a small group of firs growing well at Brooklyn Botanic Garden, where summers are usually warm and dry. A sizable Korean fir grows at the Arnold Arboretum, Jamaica Plain, Massachusetts, which introduced the species to the U.S. B, SM, CR-s.

Cork-bark fir *(Abies lasiocarpa* var. *arizonica)* (6). The species has the widest natural distribution of any native fir (Alaska to New Mexico), while the variety is found in the mountains of Arizona. A tree with glaucous needles, unsatisfactory in the eastern U.S., but of some use in Southwestern gardens. B, CR, CR-s, FA-s, SC-s.

Red fir *(Abies magnifica)* (5). A mountain tree of Oregon and California. Red fir was introduced to cultivation (Britain) in 1851 by Edinburgh gardener John Jeffrey (1826-1854?), whom a Scottish plant group sent to the Pacific Northwest to find new plants for Old World gardens. Probably best in the moist climate of the Northwest. Fine specimens of var. *shastensis*, with strikingly whorled branches, grow at the Hoyt Arboretum, Portland, Oregon. This municipal collection is one of the most extensive in the U.S. CR, RA, SF, CR-s.

*Nordmann fir *(Abies nordmanniana)* (4). One of the more commonly planted firs. The tree grows wild in the western ranges of the Caucasus and in the mountains south of the Black Sea. In cultivation since at least 1848. An especially good specimen grows at Planting Fields Arboretum, Oyster Bay, Long Island. B, CR, ES, SF, CR-s, FA-s, SC-s, TM-s.

Spanish fir *(Abies pinsapo)* (6). When well grown, this fir from the mountains of southern Spain can be attractive with its short, dense, rigid needles. Introduced to America before the middle of the 19th century, but seldom planted. A good specimen of this fir grows at the Bayard Cutting Arboretum, Long Island. B, ES, CR-s, FA-s, TM-s.

***Noble fir** *(Abies procera;* **synonym,** *A. nobilis)* (5). This fir can grow to 250 feet on the slopes of the Cascade Mountains in Oregon and Washington. While not usually thriving in the eastern U.S., noble fir grows well at Winterthur Museum, Delaware. Introduced to Britain in 1830. B, CR, ME, RA, SF, CR-s, FA-s, SC-s, TM-s.

***Veitch fir** *(Abies veitchii)* (3). John Gould Veitch (1839-1870), plant hunter for the English nursery of the same name, found this fir on Japan's Mount Fujiyama in 1861 but did not then send seed to the home firm, which was renowned for its conifer introductions. Thomas Hogg, Jr. (1820-1892), a new York City nurseryman whom Abraham Lincoln appointed United States Marshal in Japan, introduced the Veitch fir to America in 1876. The white undersides of the needles are outstanding on a windy day. A relative dwarf among firs—to 75 feet. CR, ME, RA, SF, SH, CR-s, FA-s, G-s, SC-s.

Monkey-puzzle tree *(Araucaria araucana;* **synonym,** *A. imbricata)* (7). Archibald Menzies (1754-1842), Scottish surgeon-botanist who sought out conifers in the Pacific Northwest in the 1790's, brought this tree back to England from a stopover in Chile. One of the original trees, grown on shipdeck during the return journey (to the dismay of the ship captain, who once arrested Menzies and put his gardener before the mast), lived at Kew for 100 years. As popular in English gardens last century as the Colorado blue spruce is in American ones this century, the monkey-puzzle tree stands out—perhaps too much—in warm-climate gardens because of its grotesque branching. While unsatisfactory north of the mid-Atlantic coast, the tree is the hardiest of its genus. B, RA, TM-s.

***Norfolk Island pine** *(Araucaria heterophylla;* **synonym,** *A. excelsa)* (10). A popular houseplant, but successful outdoors in only the mildest parts of the U.S., this "pine" has been in cultivation (Britain) since 1793. The Norfolk Island-pine is capable of growing to 200 feet, and mature specimens are often splendid. The tree is planted now in warm areas around the world. AM, ME, SF, ME-s, TM-s.

***Incense-cedar** *(Calocedrus decurrens;* **synonym,** *Libocedrus decurrens)* (5). Soldier-explorer-Presidential candidate (1856) John Charles Frémont (1813-1890) found this tree growing near the upper reaches of the Sacramento River in California in 1846. The very narrow columnar form, common in cultivation, can make a striking accent in moderate-climate gardens. Fine specimens grow in many West Coast collections; in the eastern U.S. at Winterthur Museum, Winterthur, Delaware, and Longwood Gardens, Kennett Square, Pennsylvania. B, CR, ME, SF, SC-s, TM-s.

***Atlas cedar** *(Cedrus atlantica)* (6). A close relative of the cedar-of-Lebanon, this tree of the Atlas Mountains of Algeria and Morocco was introduced to Western gardens about 1845 from Téniet-el Hâad by an Englishman, Lord Somers. Older specimens—with gray-green needles—are usually more upright in branching habit than the cedar-of-Lebanon. Natural hybridization of the two species occurs commonly in Europe. ME, SF, CR-s, FA-s, ME-s, TM-s.

Blue Atlas cedar *(Cedrus atlantica* 'Glauca') (6). Probably introduced about the same time as the Atlas cedar, since there are varying degrees of blue in leaves of Atlas cedars growing in their native habitat. This also occurs with cultivated forms and the best choice may often be made during a personal visit to a nursery. B, ES, G, ME, O, RA, RO, VI.

Weeping Atlas cedar *(Cedrus atlantica* 'Glauca Pendula') (6). One of the best weeping conifers—in areas where it can be grown well—this tree should be staked at an early age to form an upright leader. Seldom more than 12 feet high, and somewhat wider than it is tall. A magnificent specimen grows at the National Botanic Garden, Glasnevin, Dublin, Ireland; another at the Jardin de Meyrin, Geneva, Switzerland. The form originated in France before 1900. A, B, RA, VI.

*Deodar cedar *(Cedrus deodara)* (7). Leslie Melville introduced this tree to Britain from the Himalayas about 1822. It was probably brought to the U.S. in the late 1820's by the Prince Nursery of Flushing, Long Island. There are several stately specimens growing in the Royal Botanic Gardens, Kew, England, and other fine trees can be found in the warmer parts of Europe. Planted in California since the 1860's. One of the great trees of the world. B, CR, ES, G, RO, SF, CR-s, FA-s, G-s, ME-s, SC-s, TM-s.

Kashmir deodar cedar *(Cedrus deodara* 'Kashmir') (5). A promising form because it is hardier than the species. Gardeners may ask their nurserymen to order Kashmir deodar cedar from Princeton Nurseries, P.O. Box 191, Princeton, New Jersey 08540. Princeton is a wholesale firm serving other nurseries and does not deal directly with the home gardener. Please do *not* send orders for this tree to Princeton if you are not a nurseryman.

Cedar of Lebanon *(Cedrus libani)* (5-6). The cedar of the ancients—and one of the most famous of all conifers. Flat-topped old specimens with horizontal branching are now common in European gardens, for the tree has been planted there since at least 1650, but the tree is now rare in the Lebanese hills. It was grown at Williamsburg by early American settlers. In the Northeast one of the largest cedars of Lebanon, planted about 1835 by Minshall and Jacob Painter, is at the Tyler Arboretum, Lima, Pennsylvania. It is a few steps away from an equally old ginkgo. B, ES, G, W, CR-s, FA-s, G-s, ME-s, SC-s, TM-s.

Plum-yew *(Cephalotaxus harringtonia* var. *drupacea;* synonym, *C. drupacea)* (5). A widespreading shrub growing to about 10 feet in gardens, although it can grow as tall as 40 feet in the mountain forests of Japan. This yew-like shrub with sharp comb-like needles is mainly for the "compleat collector." Henry Winthrop Sargent (1810-1882), America's first conifer collector of any note, grew it for many years in his garden in Beacon, New York. A sizable specimen may be seen at the New York Botanical Garden, Bronx, New York and Morris Arboretum, Philadelphia, Pa. B, ES, SC-s, TM-s.

Columnar plum-yew *(Cephalotaxus harringtonia* 'Fastigiata'; synonym, *C. pedunculata fastigiata)* (5). A dense erect shrub with large needles, somewhat like a Hicks yew in habit. Usually no higher than 8 feet, and becoming more open with age. A fine specimen grows in the alpine garden at Wisley (the garden of the Royal Horticultural Society) in England. Siebold introduced the shrub to the West (Holland) from Japan in 1830. B, ES, ME, RA.

Lawson-cypress *(Chamaecyparis lawsoniana)* (5). A remarkably variable conifer introduced to cultivation by Scotsman William Murray, who found it growing on the southern flanks of Mount Shasta, California, in 1854. Named for Charles Lawson (1794-1873), nurseryman and Lord Provost of Edinburgh, whose 3-volume *Pinetum Britannicum* was published posthumously in 1884. Some 200 forms, including many dwarfs, are known. The species has been of much greater importance to European horticulture than to American. It does not thrive for long periods in the eastern U.S., and on the West Coast it suffers from several maladies. Species and forms available from HL, RA, SF, W, FA-s, SC-s, TM-s.

*Nootka-cypress *(Chamaecyparis nootkatensis)* (4). Archibald Menzies saw this tree along the shores of Nootka Sound, British Columbia in 1793, but introduction came much later and in a roundabout manner. It appeared in the botanic garden of St. Petersburg (now Leningrad) about 1850 as *Thujopsis tschugatskoi,* purportedly found on the west coast of the Kamchatka Peninsula (where it is not known to exist). It appeared in Paris' Jardin des Plantes as *Thujopsis borealis* in 1853, and a few years later the tree was being grown in American collections under the latter name. No retail source known.

Weeping Nootka-cypress *(Chamaecyparis nootkatensis* 'Pendula') (4). A graceful tree when grown in a cool, moist climate. A fine specimen grows at the Geneva (Switzerland) Botanic Garden. The commonly grown form in Europe originated in a Dutch nursery before 1884, but degrees of pendulous habit can be observed in trees native to the Pacific Northwest. Not a weeping tree like the Sargent hemlock, for the leader in this false-cypress is erect, and the tree itself can grow to good size. B, RA, SH.

*__Hinoki-cypress__ *(Chamaecyparis obtusa)* (3). George Rogers Hall, M.D. (1820-1899) introduced this important Japanese forest and ornamental tree to America in 1862. It is regarded as a sacred tree among followers of the Shinto faith. The fine-grained durable wood is used extensively for furniture in Japan, also for the construction of temples. The palaces of the Mikado in Kyoto have much Hinoki wood in them. The leaves of this rather slow-growing false-cypress are deep green, but not somber, and the tree grows well in the eastern U.S. CR, G, ME, CR-s, Fa-s.

Slender Hinoki-cypress *(Chamaecyparis obtusa* 'Gracilis') (3). The most common of the tree forms of the variable Hinoki-cypress. It may eventually attain 15 ft. B, HL, ME, RO, SF, W, WFF.

Sawara-cypress *(Chamaecyparis pisifera)* (3). Nearly always encountered in its garden forms, which are many. While faster growing than the Hinoki, the Sawara-cypress often ages poorly. Several of the forms advertised as dwarf reach good size, although not 100 feet or so, the height the Sawara cypress attains in Japanese forests. Another introduction of Dr. Hall (in 10 forms). Splendid old specimens grow in the Bayard Cutting Arboretum, Oakdale, Long Island, and in the Hunnewell Pinetum, Wellesley, Massachusetts. The spreading lower branches have not been trimmed and these trees now form impressive thickets.

Boulevard-cypress *(Chamaecyparis pisifera* 'Boulevard'; synonym, *C. p.* 'Cyano-Viridis') (3). One of the most striking blue foliage trees, this Sawara form originated with the Boulevard Nurseries, Newport, Rhode Island before 1934. It is not a dwarf, although the ultimate height is unknown. B, CR, G, ME, RA, SF, W.

Thread-leaf cypress *(Chamaecyparis pisifera* 'Filifera') (3). A tree with delicate whip-like branchlets, eventually growing to 60 feet or more, although usually offered as a dwarf. Often wider than tall. Like other Sawara forms, it grows best in a humid climate. In dry conditions, growth is open and the tree frequently becomes shaggy in a short time. While it is important that all conifers go into winter well watered, it seems especially so with Sawara forms. Otherwise, there may be unsightly—and persistent—dead leaves in spring to mar the beauty of these trees. A, SH, W.

Plume-cypress *(Chamaecyparis pisifera* 'Plumosa') (3). Another Sawara form which can attain good tree size. The delicate frond-like branchlets make it more refined than others of its kind, but unfortunately the tree is usually not correctly used in home gardens. It should have an open spot for permanent planting and not be grown near a house foundation. Like other Sawara and Hinoki forms, few pests attack it. B, W.

Moss-cypress *(Chamaecyparis pisifera* 'Squarrosa') (3). The feathery silvery leaves of this form which also grows to good size, are distinct. The shredding, reddish-brown bark of older specimens adds to the character of this and other Sawara forms. B, ES, HL, RO, WFF.

Atlantic white-cedar *Chamaecyparis thyoides)* (4). A native tree of the Atlantic seaboard, often found in marsh areas. It is a characteristic conifer of the New Jersey Pine Barrens. While perhaps not as attractive as other false-cypresses, the Atlantic white-cedar can be useful in some Eastern gardens. Cultivated since colonial days in this country, but more widely appreciated in Europe, where about 19 forms are known. Peter Collinson (1694-1768) introduced it to England in 1736. Can grow to 75 feet or so, usually much less in cultivation. B, O, W.

***Cryptomeria** *(Cryptomeria japonica)* (6). A valuable ornamental and forest tree of Japan, where it can attain 150 feet or more. Also native to China, but the Chinese variety, which was grown in the U.S. in the 1840's, is tender and perhaps no longer cultivated here. The tall form 'Lobbii' was once distinct, but it is much diluted today in the nursery trade and is said to be hardly different from the type. In fact, plants offered as 'Lobbii' are usually dwarf forms. While there is only one species of Cryptomeria, it is highly variable. About 50 forms, many of which are dwarf, have been known in the West, undoubtedly more in Japan. The variability extends to hardiness. Cryptomeria and forms available from B, ES, ME, RA, RO, VI, W, FA-s, SC-s, TM-s.

China-fir *(Cunninghamia lanceolata)* (7). Because of its sharp, large,somewhat yew-like leaves, the China-fir is one of the most distinct conifers, and, like the monkey-puzzle tree, is difficult to include in gardens for that reason. While it can be grown in New York City, it is a tree primarily for milder parts of the country. China-fir is an important forest species in the mountain valleys of Central and South China (also growing on the Island of Chusan). It has the ability, rare among conifers, to sprout from the stump when cut to the ground. William Kerr introduced the tree to the West (Britain) in 1804. The form 'Glauca' is reportedly hardier than the type, but this has not been so at Brooklyn Botanic Garden. B, ES, RA, TM-s.

***Leyland-cypress** *(Cupressocyparis × leylandii)* (6). A bigeneric hybrid (*Cupressus macrocarpa* x *Chamaecyparis nootkatensis*), six seedlings of which were found growing in 1888 at Leighton Hall, Welshpool, England. Several specimens at Kew Gardens are now about 80 feet tall. In recent years the tree has been common in the English and Dutch trade because of its exceptionally fast growth and suitability for hedges. It may eventually replace *Thuja occidentalis* as the ubiquitous tall evergreen hedge in Europe. Roots readily from cuttings (under mist propagation) and four forms have thus far been named. No retail source known, but your local nurseryman can order plants for you from the wholesale Monrovia Nurseries, Azusa, Calif. 91702.

***Arizona cypress** *(Cupressus arizonica)* (7). An often narrow-growing tree with gray or gray-green foliage, sometimes to 70 feet in the hills of Arizona, New Mexico and northern Mexico. Cultivated (correctly or not as *C. arizonica*—see page 10) in the American West and in Europe, but unsatisfactory in the northeastern U.S. A few Northern wholesalers list a reputedly hardier strain. Missionary-botanist Edward Lee Greene (1843-1915), founder of the Department of Botany at the University of California, came upon the Arizona cypress near Clifton, Arizona in 1880, and soon thereafter the Arnold Arboretum introduced it to cultivation. ME, SF ,CR-s, FA-s, SC-s.

Modoc cypress *(Cupressus bakeri)* (5). Of interest as the only true cypress hardy in the Northeast. Young specimens are growing at the Arnold Arboretum, near Boston, Massachusetts. That arboretum introduced the Modoc cypress in 1917. Native to the Siskiyou Mountains of Oregon. B.

*Kashmir cypress *(Cupressus cashmeriana)* (?9). This intensely weeping, silver-leaved cypress is listed by a Dutch firm (L. Konijn & Co., Reeuwik, Netherlands), but does not appear to be in the American trade. A striking specimen is in the Temperate House at the Royal Botanic Gardens, Kew, England, while a plant is reputed to be growing under glass at Longwood Gardens, Kennett Square, Pennsylvania. Origin and European introduction uncertain, but Planting Fields Arboretum, Oyster Bay, Long Island was probably the first to grow it in America. A specimen grows in the Strybing Arboretum, San Francisco, but it suffers.

Monterey cypress *(Cupressus macrocarpa)* (7). A picturesque tree growing to 70 feet in its well-known, very small native range—along the windswept Monterey, California, coast; taller under English cultivation. A fine conifer for coastal plantings where hardy. Despite its restricted natural habitat, the Monterey cypress is surprisingly variable, there being about 18 named forms (mostly in the European trade). English conifer enthusiast Aylmer Bourke Lambert (see *Pinus lambertiana*) introduced the tree to cultivation in 1838—from seeds of unknown origin. SF, CR-s, FA-s, SC-s, TM-s.

*Columnar Italian cypress *(Cupressus sempervirens* var. *sempervirens;* synonym, *C. sempervirens* 'Stricta') (7). A magnificent sentinel of a tree, common in Mediterranean gardens since antiquity, but satisfactory in only some of the warmer parts of the U.S. No other conifer grows as tall (to 75 feet), yet remains so narrow (6-7 feet). Since Linnaeus described this tree as the type, it should bear the above name, although it is in fact a cultivar. When raised from seed there is considerable variation and the true form has to be selected. Probably introduced to America in colonial times. CR-s, FA-s, ME-s, SC-s, TM-s.

Spreading Italian cypress *(Cupressus sempervirens* var. *horizontalis)* (7). Despite the curiosities of nomenclature, this is the species found in the wild from the eastern Mediterranean to Iran—and escaped from cultivation throughout the Mediterranean world. Cypress trees are long-lived and their notably durable wood has often been used in cathedrals and mosques. The aromatic wood is repulsive to insects, hence useful for clothes chests. Cypresses, particularly the columnar form, are widely planted in southern European cemeteries, much as the English yew is planted in northern ones. Probably introduced to the U.S. in colonial times. CR-s, FA-s.

*Rimu *(Dacrydium cupressinum)* (?9). A rare conifer from New Zealand, where it is a timber tree growing from 60 to 180 feet. A 15-foot tree with a fine weeping appearance grows at the Strybing Arboretum, San Francisco. It is probably not in the American trade.

*Chinese juniper *(Juniperus chinensis)* (4). A variable species, being prostrate as in var. *sargentii,* shrubby as in 'Pfitzeriana', or a sentinel-like tree in 'Columnaris'. More than 65 forms are known. The plant is native to China, Mongolia and Japan. William Kerr introduced the Chinese juniper to England in 1804—along with the China-fir (*Cunninghamia lanceolata*). Forms available from many nurseries, such as: CR, G, ME, RO, SH, SF, CR-s, FA-s, G-s, ME-s, SC-s.

*Swedish juniper *(Juniperus communis* var. *suecica)* (2). A columnar tree found growing wild to 30 feet or so in Scandinavia. Cultivated in the U.S. since the late 18th or early 19th century. The species from which it is derived, the common juniper (*Juniperus communis*), has the widest range of any conifer, for it is native to such diverse areas as New England, Sweden, Iran, the western Himalayas and northeastern Asia. The low spreading American variety *depressa* is often planted. In the nursery trade Swedish juniper is sometimes confused with the more narrow, dark green—and more tender—Irish juniper (*J. c.* 'Stricta';

synonym, *J. c. hibernica*). ES, SH.

Needle juniper ***(Juniperus rigida)*** (5). A graceful small tree with weeping branchlets, growing to about 25 feet in cultivation; and occasionally a widespreading pendulous shrub, as is a specimen at Brooklyn Botanic Garden. While distinct among junipers, it does not appear to be as tolerant of dry conditions as the more common kinds. Native to hills and valleys of Japan, Korea and China. John Gould Veitch introduced it to England in 1861, and from there it soon made its way into American collections. A, B, RA, CR-s, FA-s, G-s, ME-s.

Western red-cedar** ***(Juniperus scopulorum) (5-7). An often narrow tree which can attain 40 feet. In the wild it is native mainly to elevations of 5,000 ft. or more, from British Columbia to Alberta and Texas. Midwestern nurseries have selected a number of grayleaf columnar forms in recent years. Discovered on the Lewis and Clark expedition in 1804, but considered for many years to be a variety of eastern red-cedar (*J. virginiana*). Charles Sprague Sargent (1841-1927), first director of the Arnold Arboretum, gave it specific rank late in the 19th century when he noticed that its fruits took two years to ripen (fruits of *J. virginiana* ripen the first year). *J. scopulorum* forms have done poorly at the Brooklyn Botanic Garden. Probably introduced by the Arnold Arboretum. Species and forms available from A, B, EF, G, ME, RA, SH, CR-s, FA-s, G-s, ME-s, SC-s.

Eastern red-cedar** ***(Juniperus virginiana) (2). A variable tree with a large range: Canada to Florida and east of the Rockies. One of the tallest of the junipers—to about 90 feet in the wild, but considerably less in cultivation. Characteristic of abandoned fields in the eastern U.S., where it is one of the first woody plants to become established, provided the soil is not overly acid. Grown since colonial times. Species and forms available from CR, EF, ES, G, HL, KN, ME, SF, SH, W, CR-s, G-s, ME-s, SC-s.

Père David keteleeria** ***(Keteleeria davidiana) (?7). A fir relative, growing to 100 feet in dry woods in central, southwestern and western China, but seldom cultivated in the U.S. The name honors two men: Père Armand David (1826-1890), the French missionary who discovered it in 1869 and Belgium-born nurseryman Jean Baptiste Keteleer (1813-1903), whose firm in Sceaux, France, Thibault & Keteleer, was in the forefront of conifer introductions on the Continent. No source known.

Incense-cedar** ***(Libocedrus decurrens). See *Calocedrus decurrens.*

European larch ***(Larix decidua;*** **synonym,** ***L. europaea)*** (2). A tall tree from the Alps and Carpathian Mountains of central Europe, and probably the most commonly planted larch in the eastern U.S. Where pests are not a problem, it can provide a fine contrast to some of the stiff, somber conifers. The light green needles (which are shed in autumn, as they are in all larches), the open habit and frequently pendulous branchlets at maturity make the European larch a distinctive tree. It is exceptionally hardy, reasonably tolerant of wet sites, and does better under urban conditions than many other conifers. Grown in America since early colonial times. B, CR, G, RO, SF, FA-s, G-s, SC-s, TM-s.

Japanese larch ***(Larix kaempferi;*** **synonym,** ***L. leptolepis)*** (4). A tall tree native to the mountains of Central Honshu. Donald Wyman, Horticulturist of the Arnold Arboretum, considers it the best ornamental larch. It is apparently faster growing than other larches and somewhat resistant to larch canker. It was named for Engelbert Kaempfer (1651-1716), chief surgeon of the Dutch East India Company, who was an early botanical traveler in Japan. John Gould Veitch sent seeds to England in 1861 and one of the trees grown from this seed was grown by Horatio Hollis Hunnewell (1810-1902) in his famous conifer collection at Wellesley, Massachusetts. B, RO, SF, FA-s, G-s, SC-s, TM-s.

Tamarack *(Larix laricina)* (1). Of special interest because it is one of the hardiest of all trees, native from the Arctic Circle to Pennsylvania. A characteristic tree of Northern wetlands. While perhaps not as satisfactory in cultivation as other larches, this primarily cool-climate tree has lived for many years in the Local Flora Section of the Brooklyn Botanic Garden, where summers are often dry. The tamarack is of smaller eventual height than other larches—to about 60 feet. Cultivated since the early 18th century, but seldom planted today. FA-s.

Western larch *(Larix occidentalis)* (5). The tallest of the larches (to 240 feet), native from British Columbia to Montana and Oregon, and of use largely in the West, although trees are known in the eastern U.S. David Douglas found the trees along the Columbia River in 1826, but it was apparently not introduced until 1880 when seeds were grown at the Arnold Arboretum. M, SF, SC-s.

***Metasequoia** *(Metasequoia glyptostroboides)* (4). A fast-growing deciduous conifer which—to the horticultural eye—resembles a bald-cypress (*Taxodium*) more than it does a redwood (*Sequoia*). In 1941 T. Kan, a Chinese botanist, found it growing in Mo-tao-chi, Szechuan Province, but the nature of the discovery went unknown until 1945 when specimens collected by T. Wang were determined to be from a genus until then known only from fossils. The Arnold Arboretum introduced metasequoia to western cultivation in 1948. Specimens over 50 feet are already known in the U.S. Growth-rate appears best in somewhat moist soil, although the tree tolerates a variety of growing conditions. A 45-foot tree at Brooklyn Botanic Garden produced cones in 1969 for the first time. In nursery catalogs metasequoia is often called dawn-redwood. B, ES, ME, O, RO, SF, SH, VI, W.

Norway spruce ***(Picea abies;* synonym, *P. excelsa)*** (2). A fast-growing, eventually tall conifer, attractive in its first few years, but often aging poorly. The deep green needles and long weeping branchlets of mature trees provide a somberness perhaps unmatched by any other conifer. While rather adaptable, Norway spruce appears at its best in humid climates. Very common and frequently planted without enough space to develop properly. Best in its dwarf forms. Brought over in colonial times from Europe, where it has an extensive natural range: Scandinavia to the Balkans and central Russia. B, CR, EF, ES, G, ME, MU, RO, SF, SH, CR-s, FA-s, G-s, ME-s, SC-s.

Weeping Norway spruce ***(Picea abies* 'Pendula'; synonym, *P. excelsa* 'Pendula')** (2). A collective group of weeping forms, hence variable. Often planted in Europe, especially in cemeteries, where old specimens can approach the grotesque. One of the most distinct is 'Inversa', found in Shropshire, England about 1855. Good specimens may be seen at the entrance to Longwood Gardens, Kennett Square, Pennsylvania. Eventually growing to about 30 feet. ME, O, RA, VI.

***Siskiyou spruce** *(Picea breweriana)* (5). A more refined tree than the common Norway spruce—and more gracefully weeping in older specimens. Siskiyou spruce has the smallest natural range of American spruces, the Siskiyou Mountains in southwestern Oregon and northern California. The botanical name honors Yale professor William Henry Brewer (1828-1910), who was probably the first botanist to find the tree (1863). The Arnold Arboretum brought the tree into cultivation in the early 1890's. Slow-growing, with few cultivated specimens over 35 feet; occasionally to 120 feet. B, CR, ME, RA, SF, CR-s, SC-s, TM-s.

Engelmann spruce *(Picea engelmanni)* (2). A tall tree of the Rocky Mountains, from Alberta to New Mexico, west to the Cascades and often with blue-green needles similar to Colorado blue spruce (*P. pungens* 'Glauca'), but soft to the touch. Explorer-botanist Charles Christopher Parry (1823-1890) discovered Engelmann spruce growing on Pike's Peak in 1862 and in the following year sent seed to the old Harvard University Botanic Garden in Cambridge, Massachusetts. The tree is named for George Engelmann (1809-1884) of the Missouri Botanical Garden, one of the leading conifer students of the 19th century. CR, ES, G, SF, CR-s, FA-s, G-s, SC-s.

White spruce *(Picea glauca;* synonyms, *P. alba, P. canadensis)* (2). A medium-to-large-size tree of the North Woods with a wide range—Alaska to New York. White spruce is primarily a tree for cold climates where the choice of conifers is rather limited, although it can grow satisfactorily in somewhat warmer areas, too. The short, often bluish needles can be delicately attractive on good specimens. A variable species with several geographical varieties and horticultural forms. The popular dwarf Alberta spruce (*Picea glauca* 'Conica') is derived from this species. Cultivated since colonial times. EF, ES, HL, KN, ME, MU, SF, SH, W, CR-s, G-s, SC-s.

Black Hills spruce *(Picea glauca* 'Densata') (2). A dense, rather slow-growing form of the white spruce. Cultivated in a South Dakota nursery about 1920. Useful in the central U.S. ME, MU.

Serbian spruce *(Picea omorika) (4). A distinct spruce, usually quite narrow in growth habit in older specimens. Native to limestone cliffs along the Drina River in Yugoslavia. Trees planted at the Arnold Arboretum in the late 19th century are 60 feet tall and only 15 feet wide. Serbian botanist Josef Pancić (1814-1888) discovered this spruce in 1875. Probably first cultivated by the Frobel Nursery of Zurich, Switzerland about 1884. B, CR, ME, MU, RO, SF, SH, CR-s, FA-s, ME-s, SC-s, TM-s.

Oriental spruce *(Picea orientalis) (4). A tall-growing tree with a clean appearance, but not as stiffly formal as some other spruces. The short dark green needles are as refined as those of any species in the genus. Native to the Caucasus and northeastern Anatolia, where it can grow to more than 150 feet. Fine specimens at Winterthur, Delaware and Tyler Arboretum, Lima, Pa. RA, SF, SH, CR-s, SC-s, TM-s.

***Colorado and Colorado blue spruce *(Picea pungens, Picea pungens* 'Glauca' and other forms)** (2). A well-known tree, especially in its blue-needle forms. Colorado spruce is a slight misnomer, for it is also native to New Mexico, Utah, and Wyoming—along stream banks and rocky ledges at elevations of 6,000 to 11,000 feet. Found by Charles Christopher Parry on Pike's Peak, 1862. Charles Sprague Sargent grew one of the first blue spruces in his own Brookline, Massachusetts garden, the tree originating from seeds collected by Parry. Blue spruce became quickly popular and is today probably the most commonly planted tall conifer in the U.S. However, as botanist George Engelmann aptly remarked in 1877: "To be beautiful and striking it must be young." Colorado spruce forms: nearly all nurseries in the temperate parts of the U.S.

Sitka spruce *(Picea sitchensis) (6). A coastal tree native from Kodiak Island in Alaska to northern California. Seen by Menzies along Puget Sound (1792), introduced by Douglas to cultivation in Britain (1831), where, because of its timber, it has become the most important exotic conifer. Charles S. Sargent paid this tribute: "The greatest of all Spruce-trees, this inhabitant of the northwest coast is surpassed by few other trees in thickness and height of stem. No tree in the American forest grows with greater vigor or shows greater evidence of vitality, and there are few more beautiful and impressive objects in the forests of temperate North America than one of these mighty Spruce-trees with its spire-like head raised high above its broad base of widely sweeping and gracefully upturned branches resting on the surface of the ground, its slender branchlets loaded with handsome cones nodding in the slightest breeze, and its leaves, now silvery white and now dark and lustrous, shimmering in the sunlight." Sitka spruce grows best in a cool moist climate. B, CR, ME, RA, SF, CR-s, FA-s, G-s, SC-s, TM-s.

*****Himalayan spruce** ***(Picea smithiana;*** **synonym,** ***P. morinda)*** (6). A tall conifer with weeping branches and long dark green needles, native from Afghanistan to Nepal. Little known in cultivation, although introduced to Britain in 1818. Henry Winthrop Sargent grew it in his large conifer collection at Beacon, New York in the mid-19th century. Young trees thrive at the Hoyt Arboretum, Portland, Oregon. CR-s.

Wilson spruce ***(Picea wilsonii)*** (5). A dense, somewhat slow-growing tree native to the mountains of central China. Named for its collector, Ernest Henry "Chinese" Wilson (1876-1930), who delivered it to Veitch's Nursery, England, in 1901. An explorer for Veitch's and (after 1906) for Massachusetts' Arnold Arboretum, Wilson introduced about 1,500 different kinds of plants, including the regal lily (*Lilium regale*), beauty-bush (*Kolkwitzia amabilis*) and Korean box (*Buxus microphylla* var. *koreana*). Good specimens of Wilson spruce grow at the Bayard Cutting Arboretum, Oakdale, Long Island, N.Y. ME.

Bristlecone pine ***(Pinus aristata)*** (5). A picturesque mountain pine native from Colorado to Arizona and California. A gnarled tree in Inyo National Forest in east-central California is over 4,600 years old. While bristlecone pine is occasionally a tree growing to 40 feet in the wild, it is only a dwarf shrub when planted in the eastern U.S. It is often short-lived in the New York area. Charles Christopher Parry found the tree in 1861. B, CR, G, ME, MU, O, RA, SF, WFF, CR-s, FA-s, G-s, SC-s.

Armand pine ***(Pinus armandii)*** (5). A five-needle pine from China, Taiwan and Korea, growing to at most 60 feet. The needles are somewhat longer than those of eastern white pine (*P. strobus*), and the habit of the tree is more open, with horizontal branching. Named for French missionary-botanist Père Armand David (1826-1900) (whose last name is commemorated in *Davidia*, the dove-tree), who found the species growing in the mountains south of the Yellow River in Shensi, China in 1873. Another priest, Père Paul Guillaume Farges (1844-1912) introduced Armand pine to western cultivation by sending seed to the Vilmorin Nursery of France in 1895. The Arnold Arboretum obtained plants grown from this seed in 1902. B, RA, CR-s.

Jack pine ***(Pinus banksiana)*** (2). A very hardy, somewhat coarse pine with short needles in pairs, mainly of value because it will grow better on dry, gravelly slopes than most other pines. Native from the Mackenzie River Valley near the Arctic Circle to northern New York, jack pine can attain 90 feet in the wild, but is often a small tree or even shrubby. A pine that might lend itself well to form training. Named for Sir Joseph Banks (1743-1820), patron of the natural sciences, botanical traveler and honorary director of England's Kew Gardens. The tree was early cultivated, at least in England, where William Forsyth (1737-1804) grew it in 1783. CR, O, RA, SF, W, CR-s, FA-s, G-s, SC-s.

Lace-bark pine ***(Pinus bungeana)*** (4). A medium-size pine from northwestern China, often cultivated around temples, where massive-trunked trees become white with age. At an earlier stage the bark is a checkered red-brown and white, much like a stewartia. A very distinctive conifer for this reason, but the rather short needles, in groups of threes, have mediocre texture and the tree, usually developing several trunks near the base, is prone to storm damage. Pruning to develop clean trunks accentuates the beauty of lace-bark pine. Trees trained to a single trunk may be longer-lived but are less attractive. Named for Alexander von Bunge (1803-1890), Russian botanist who found the tree growing near Peking in 1831. Englishman Robert Fortune (1812-1880) introduced lace-bark pine to the West in 1846. A good 19th-century specimen grows at Craig House Sanitarium, Beacon, N.Y. Younger specimens may be seen in many arboretums, including the Brooklyn Botanic Garden and Morris Arboretum, Philadelphia, Pa. B, O, RA.

*Swiss stone pine *(Pinus cembra)* (4-2). A fine-textured, dense five-needle pine, often with narrow habit, from the Alps and Carpathian Mountains of Central Europe (also Siberia). Occasional trees may attain 60 feet or so. Rather slow growing in cultivation, usually to not more than 30 feet. Of special value for smaller gardens. Swiss stone pine has been cultivated since at least 1746, when the Duke of Argyll introduced it to England. ME, O, RA, VI, W, WFF, CR-s, FA-s, G-s, SC-s, TM-s. Var. *sibirica* (a hardier variety): CR-s.

Pinyon or nut pine *(Pinus cembroides* var. *edulis)* (4). A stubby, generally two-needle pine occasionally growing to 45 feet in its native habitat (south Wyoming to Arizona, Texas and New Mexico); a slow-growing, rounded shrub in cultivation. Of interest as one of the pines with edible seeds. The needles are short and stiff. German-born Friedrich Adolph Wislizenus (1810-1889), who practiced medicine in St. Louis, Missouri for many years and a good friend of George Engelmann, found pinyon pine in New Mexico in 1846. B, CR, SF, W, CR-s, FA-s, SC-s.

Lodge-pole pine *(Pinus contorta* var. *latifolia)* (5). The most common pine of the northern Rocky Mountains, where it can grow to large size. The twisted short needles are arranged in pairs. While there are better pines for other parts of the country, lodge-pole pine has its uses in the mountain states and adjacent Canada. The common name is derived from the Indian custom of using the tapering trunk for center-poles on huts. Scottish plant-hunter John Jeffrey found the tree in 1853. CR, G, ME, SF, CR-s, FA-s.

Japanese red pine *(Pinus densiflora)* (4). A tall, asymmetrically spreading orange-bark pine with a wide range in Japan. For a two-needle pine, the foliage is rather refined, although it turns yellow-green in winter. Siebold introduced the tree to the West (Netherlands) in 1852. A good specimen grows in the Arnold Arboretum, Jamaica Plain, Massachusetts. CR, RA, SF, CR-s, FA-s, SC-s, TM-s.

Tanyosho pine *(Pinus densiflora* 'Umbraculifera) (4). A splendid umbrella form of the Japanese red pine, seldom more than 10 feet at maturity. The dense head can suffer from heavy snows, but the habit of the tree and the orange bark make Tanyosho pine unique. Long cultivated in Japan. Grown in the U.S. since 1862, when George Rogers Hall delivered it to Parson's Nursery, Flushing, Long Island. A fine old specimen grows in the New York Botanical Garden's Montgomery Collection. A, B, G, O, RA, VI, WFF.

Limber pine *(Pinus flexilis)* (2). A slow-growing, five-needle pine with comparatively short needles (1½-3 inches), native to a large part of the American West (Alberta to Texas and the Pacific Coast). Occasionally grows to 75 feet in the wild, but much less in gardens. A good blue-needle form grows near the entrance to Brooklyn's Green-Wood Cemetery. An attractive specimen grows near the entrance of Morris Arboretum, Philadelphia, Pa. B, CR, G, O, RA, SF, CR-s, FA-s, G-s, ME-s, SC-s.

Jeffrey pine *(Pinus jeffreyi)* (5). A lofty pine from Oregon and California with rather long (5-8 inches), bluish-green needles in groups of three. Will grow in the Northeastern U.S., but more satisfactory in the West; also in Europe, where one of the oldest cultivated specimens is growing on the Isle of Mainau (West Germany) in Lake Constance. The name honors John Jeffrey (1826-1854?), a young Scottish gardener whom the British-sponsored Oregon Botanical Expedition sent out to the Pacific Northwest to find new plants. Jeffrey introduced many previously unknown species before his mysterious disappearance in 1854. B, CR, ME, SF, CR-s, G-s, SC-s.

Korean pine ***(Pinus koraiensis)*** (3). A rather slow-growing, asymmetrically spreading five-needle pine from Korea, Japan, Manchuria and the far eastern part of the Soviet Union. It is capable of attaining large size, but probably not much over 50 feet in the northeastern U.S. Unlike some pines, its good foliage is retained in winter. According to Ralph Hicks of Hicks' Nursery, Westbury, Long Island, his well-known horticulturist uncle, Henry Hicks, was especially fond of Korean pine and built up stock to a point where he frequently had to substitute it on orders for the common eastern white pine (*P. strobus*). Korean pine is rare in the trade today, but sizable specimens can be found on Long Island. One is growing at Old Westbury Gardens. CR-s, G-s, SC-s.

Sugar pine ***(Pinus lambertiana)*** (5). A giant among pines; in fact, the tallest growing of all pines. David Douglas, upon finding the tree on the headwaters of the Umpqua River in southeastern Oregon in 1825, measured a fallen specimen of 245 feet. Gardeners may take some comfort in the knowledge that this often narrow, five-needle pine is slow-growing in cultivation. Seldom planted in the northeastern U.S., although it can exist for many years, as it has at the Arnold Arboretum. Douglas named the tree for Aylmer Bourke Lambert (1761-1842), English patron of science and a founder of the Linnaean Society. B, CR, SF, CR-s, FA-s, ME-s, SC-s.

Mugo pine ***(Pinus mugo*** **and forms)** (2). A stiff, shrubby, short two-needle pine, sometimes prostrate and seldom exceeding 10 feet in gardens. Native from the mountains of Spain to the Balkans, where it is occasionally a tree over 30 feet. Very variable from seed, with several varieties and forms. Long cultivated, but introduction to cultivation obscure. B, CR, EF, G, HL, ME, MU, RO, SF, SH, VI, W.

Austrian pine** ***(Pinus nigra **var.** ***nigra;*** **synonym,** ***P. austriaca)*** (4). An adaptable tall-growing pine with unusually stiff needles arranged in pairs. Native from Austria to Greece. Habit varies considerably: sometimes a pyramidal tree, sometimes asymmetrically spreading. The rough deep-cinnamon bark is always interesting. Austrian pine is one of the most successful exotic pines in the U.S., growing better in cities than many others. While the tree is occasionally coarse in youth, it ages well. Old specimens with broadly rounded crown and heavy branches can be striking. CR, EF, G, HL, ME, MU, SF, SH, CR-s, FA-s, G-s, ME-s, SC-s, TM-s.

Long-leaf pine** ***(Pinus palustris; **synonym,** ***P. australis)*** (7). A tall forest tree of the Deep South, with remarkably long (9-18 inches), flexible needles arranged in threes. Long-leaf pine—one of several known in lumbering circles as "yellow pine"—is an important timber and resin-producing tree, but it also has a place in ornamental plantings in warmer parts of the country. A good specimen may be seen as far north as Philadelphia at Morris Arboretum. CR-s, FA-s, ME-s.

Japanese white pine** ***(Pinus parviflora) (5). An attractive five-needle pine from the mountains of Japan, densely growing in its early years, somewhat open and spreading at maturity. While it can attain over 80 feet, the tree is a candidate for small or medium-size gardens because of its slow growth and short refined needles. Lends itself well to form and size control. Pines that tend to become lanky can be kept compact for many years by snapping off part—or nearly all—of the new growth (the "candles") in spring. Blue-needle forms of Japanese white pine are among the most beautiful of all conifers. John Gould Veitch introduced the tree to the West (England) in 1861. B, G, ME, O, RA, SF, W, CR-s, G-s, ME-s, SC-s.

Macedonian pine ***(Pinus peuce)*** (4). An unusual, dense columnar tree from the Balkans, this slow-growing five-needle pine is reputedly not as susceptible to the weevil that often kills the leader of eastern white pine (*P. strobus*). Macedonian pine is also a tree of much smaller eventual height than white pine, which it resembles. Suitable for the small garden. The tree appears to have been first cultivated in 1863 by the firm of Haage & Schmidt, Erfurt, Germany. B, MU, RA, CR-s.

Italian stone pine ***(Pinus pinea)*** (7). A picturesque two-needle pine of the Mediterranean region with the appropriate French name of *pin parasol.* Older trees with umbrella-shaped crowns—in addition to columnar Italian cypresses—are the most striking conifers of the southern European landscape. Cultivated since early times for its edible seeds (called "pine nuts"), a staple of Middle Eastern cookery. Italian stone pine is of use only in some of the warmer parts of the U.S., although young plants have occasionally survived a few winters outdoors as far north as Long Island. SF, CR-s, SC-s, TM-s.

Ponderosa pine ***(Pinus ponderosa)*** (5). A tall, open, fast-growing pine with often long needles (usually grouped in threes), native to a large part of Western North America. Similar to Jeffrey pine, but with green needles, ponderosa is considered the most variable of American pines. It is mainly a tree for Western gardens, although it can live for many years in the eastern U.S. Henry Winthrop Sargent's 'Pendula', a narrow form with erect leader and closely set, weeping branches, dating from last century, still grows well in Beacon, New York. David Douglas introduced ponderosa pine to England in 1826. CR, EF, ME, MU, SF, CR-s, FA-s, G-s, ME-s, SC-s, TM-s.

Red pine ***(Pinus resinosa)*** (2). A handsome tall pine native from Manitoba eastward—and south to Pennsylvania. Red pine, or Norway pine as it is sometimes inappropriately called, looks much like Austrian pine, but its needles are soft, and it is not as adaptable in cultivation. Appears to do best in the cooler regions, where it is frequently planted as a tree crop. Red pine has been having insect problems in the southern part of its range, in recent years. The tree grows poorly in New York City, whereas the similar Austrian pine has been generally satisfactory over the years. Long cultivated in the U.S.; first cultivated in England in the mid-1700's. CR, ES, ME, MU, SF, CR-s, FA-s, G-s, ME-s, SC-s.

Eastern white pine ***(Pinus strobus)*** (3). The tallest inhabitant of the forests of eastern North America, where occasional specimens grew to more than 200 feet before timber was cut in earnest. White pine has long been a popular conifer because of its refined qualities, availability, and adaptability. The tree appeared early in botanical literature (Plukenet, 1696) and one of its popularizers in the 18th century was Lord Weymouth, who planted the tree at his estate in Longleat, England. To this day eastern white pine is known in England as Weymouth pine. Lately, the tree has suffered from several pests in the U.S., including white pine weevil, and it is rather susceptible to automobile fumes. While eastern white pine is still an important ornamental tree, other five-needle pines may be more desirable in some situations. Most nurseries.

Columnar white pine ***(Pinus strobus*** **'Fastigiata')** (3). Good while young, but older trees lose their columnar habit. In existence before 1884. B, G, ME, O, SH, W.

Weeping white pine ***(Pinus strobus*** **'Pendula')** (3). A curiosity, irregular in growth and never becoming a tall tree. Best to see before planting. A specimen grows in the Tallman Dwarf Garden at the Brooklyn Botanic Garden. Weeping white pine was in existence before 1866. B, G, O, VI, W, WFF.

Scots pine ***(Pinus sylvestris)*** (2). A variable pine with blue-green needles arranged in pairs, native from Scotland to North Asia. Old trees with orange bark, open trunk and branched only near the top, can be picturesque. While common Scots pine can have poor texture, good forms exist, primarily in Europe. Among them 'Argentea', var. *rigensis* (with red bark) and 'Watereri' (a dense shrub or compact tree to 12 feet). B, CR, EF, ES, G, HL, ME, MU, RA, SF, SH, W, CR-s, FA-s, G-s, ME-s, SC-s. Var. *rigensis* available from CR-s.

Japanese black pine ***(Pinus thunbergii)*** (5). A distinctly asymmetrical pine commonly planted along the North Atlantic coast because of its tolerance of sandy soil and wind. While having a reputation of relatively small size and short life—particularly under these conditions—sizable old trees are occasionally encountered. One planted last century in Henry Winthrop Sargent's garden in Beacon, New York still survives. The botanical name honors Carl Peter Thunberg (1743-1822), a Swedish botanist who was an early visitor to Japan. Siebold introduced Japanese black pine to the West (Holland) in 1852. CR, ES, G, HL, ME, MU, RA, RO, SF, W, CR-s, FA-s, G-s, SC-s.

Himalayan pine** ***(Pinus wallichiana; **synonyms,** ***P. griffithii, P. excelsa)*** (5). A graceful tall pine found growing wild at elevations of 6,000-12,000 ft. from Afghanistan to Nepal. A slight weeping effect is given by the long needles, which are arranged in fives. A specimen planted at Brooklyn Botanic Garden in 1924 is approaching 80 feet; the tallest conifer in the Botanic Garden. Old Himalayan pines are common in Brooklyn's Green-Wood Cemetery. Lambert introduced the tree to the West (England) about 1823. CR, ES, ME, SF, VI, CR-s, FA-s, SC-s, TM-s.

Yew podocarpus ***(Podocarpus macrophyllus)*** (7). A popular house plant in the northern U.S., but in Japan and China where it is native, this podocarpus with leaves a half-inch wide, can be a tree 25-50 feet high. Usually shrubby in cultivation in U.S., where it is often grown in warm-climate gardens. Introduced to the West (Britain) in 1804 by Captain Kirkpatrick of the East India Company. Available from many florists. AM.

Japanese podocarpus, Makino** ***(Podocarpus nagi) (?7). Large tree with smooth purple bark, native to Japan, China and Taiwan. Seldom cultivated in U.S., but tub specimens are grown under glass at Longwood Gardens, Kennett Square, Pennsylvania. Siebold introduced the plant to Belgium in 1830.

Golden-larch** ***(Pseudolarix amabilis; **synonym,** ***P. kaempferi)*** (5). A large deciduous tree from China with year-round interest. At its best when the new needles appear in spring; also in autumn with fine yellow tints. Old golden-larches growing in the Arnold Arboretum have the graceful weeping appearance of *Cedrus deodara.* Perfectly at home in New York City's Central Park; also at Brooklyn Botanic Garden. Robert Fortune introduced golden-larch to Britain (1853). B, ME, FA-s, SC-s.

Douglas-fir** ***(Pseudotsuga menziesii; **synonyms,** ***P. taxifolia, P. douglasii)*** (4-7). A famous—and variable—timber tree from Western North America. Archibald Menzies discovered it in British Columbia about 1792, and David Douglas introduced it to cultivation in 1827. It should not be grown near Colorado spruce (*Picea pungens*) because of the Cooley gall aphid association. Variety *glauca* (which, in fact, is not glaucous in most cases) is hardier than the type and is now commonly cultivated in the Northeast. B, ES, G, ME, MU, RO, W. Var. *glauca* (many of the preceding nurseries probably offer var. *glauca*, but the following firms are explicit): CR, EF, ME, O, SF, SH, CR-s, FA-s, G-s, ME-s, SC-s.

Japanese umbrella-pine** ***(Sciadopitys verticillata) (5). A rather slow-growing tree with a small native habitat in Japan. Remarkable because of its united needles, which are a lustrous deep green, the umbrella-pine is well adapted to smaller gardens, for it takes many years to attain 40 feet in the eastern U.S. George Rogers Hall introduced it to the U.S. in 1862. A, B, HL, ME, O, RA, RO, VI, W, CR-s, SC-s.

Redwood *(Sequoia sempervirens)* (7). The tallest tree of North America (to 340 feet), native to only the mild humid California coast (with two isolated groves in Oregon). Not for every garden, and certainly not for the northeastern U.S., but a magnificent tree where it can be grown well. Observed as early as 1769 by members of the Portola Expedition—near Watsonville, California. Apparently first cultivated at the St. Petersburg Botanic Garden, Russia, about 1840. Named for Indian Chief Sequoiah (1770-1843), inventor of the Cherokee alphabet. Many readers will agree with C.S. Sargent's summation: ". . . it is unsurpassed in magnificence by any other conifer and no coniferous forest of the continent equals in impressiveness, beauty, and luxuriance the Redwood forests of northern California." CR, ES, SF, CR-s, FA-s, ME-s, SC-s, TM-s.

***Giant-sequoia, "Big-Tree"** *(Sequoiadendron giganteum;* synonym, *Sequoia gigantea)* (6). A massive tree of California's Sierra Nevada. While more amenable to cultivation in the northeastern U.S. than the redwood, it is best in mild, humid climates. In Geneva, Switzerland, for example, it is one of the most common conifers. The tallest specimen in the eastern U.S. is at the Tyler Arboretum, Lima, Pennsylvania. Introduced to cultivation by the Veitch collector William Lobb (1809-1863), who upon hearing of the tree's existence in 1854 rushed to the scene to gather plants "which he carried to England on the first steamer leaving San Francisco." (C. S. Sargent's words). B, CR, ME, SF, VI, CR-s, FA-s, ME-s, SC-s, TM-s.

Bald-cypress *(Taxodium distichum)* (4). A tall deciduous tree of the southern wetlands (with several northern outreaches), the bald-cypress is best known for its "knees" or stubby root projections, which occur only in moist soils. While slow-growing compared with *Metasequoia*, the tree is actually very adaptable, growing well in average garden soil in the northern states. In fact, there are even street trees of this species growing in New York City (Queens). A popular conifer in the Netherlands, where much of the land is below sea level. John Bartram was probably the first American to cultivate bald-cypress in his 18th-century Philadelphia garden. However, the tree was introduced to England even earlier, about 1640, by John Tradescant. B, ES, ME, RO, SF, FA-s, ME-s, SC-s, TM-s.

***English yew** *(Taxus baccata)* (6). A spreading somber tree in old age, the yew is a tree of lore and history. Countless generations of European warriors used its wood for bows. A few years ago, in Holland, a yew axe handle dating from 1800 B.C. was unearthed. The yew is a characteristic tree of English cemeteries and churchyards, with some trees reputed to be 1,000 or more years old. Long cultivated in Europe, and introduced to America shortly after the Pilgrims landed. In the U.S. usually sold in its forms.

Irish yew *(Taxus baccata* 'Fastigiata'; synonyms, *T. b. hibernica, T. b. stricta)* (6). Narrowly pyramidal in youth, broadly columnar in old age. Usually not more than 15 feet tall in American cultivation, but large old ones are common in Europe. A fruit-bearing form found by an Irish farmer named Willis about 1780. All of the Irish yews in cultivation are thought to be descended from his find. The similar and commonly available Hicks yew (*Taxus* x *media* 'Hicksii') is more satisfactory in New England. Irish yew: ES, HL, ME.

Spreading English yew *(Taxus baccata* 'Repandens') (5). An attractive low-spreading form, usually only about 3 feet high (but about 6 feet across). Hardier than other English yews. Probably originated in Parsons' Nur-

Sugar pine *(Pinus lambertiana),* in University of Washington Arboretum. Planted before 1944; now about 30 feet tall.

William Eng

Aged sugar pine, near Union Creek in southern Oregon. It is 224 feet tall.

Genereux

The Jeffrey pine *(P. jeffreyi)* of the Northwest can be grown in Northeast.

Frederick McGourty, Jr.

Japanese black pine *(P. thunbergii)* is recommended for windswept seashores.

sery, Flushing, Long Island before 1887. B, ES, HL, ME, MK, RA, RO, VI.

*Japanese yew *(Taxus cuspidata)* (4). A popular shrub with many forms. A wide-spreading or upright tree at maturity, as it is in Japan in the wild, where it is uncommon. A dwarf spreading form, *Taxus cuspidata* var. *nana,* is often planted in American gardens, but the material in the trade varies. The finest *nana* form is the original one with short needles, introduced to the U.S. by George Rogers Hall in 1862. Old specimens grow in the Hunnewell collection, Wellesley, Massachusetts. Dwarf Japanese yew (*T. c.* var *nana*): A, B, ES, HL, RA, RO, SF, SH, W.

Hybrid yew *(Taxus media;* parentage, *T. cuspidata × baccata)* (4). Probably the most common coniferous shrub in America, the hybrid yew is a relative newcomer on the horticultural scene. Theophilus D. Hatfield, for many years Head Gardener at the Hunnewell estate in Wellesley, Massachusetts, raised a number of yew seedlings about 1900, and in 1923 one form, the Hatfield yew, was named for him. By coincidence Long Island nurseryman Henry Hicks also observed a curious Irish-type yew about the same time Hatfield was making his own discovery. Hicks' yew arose from seed collected on the C.A. Dana estate in Dorosis, Long Island. Since then, many hybrid forms have been named. Their importance for northern gardeners has been great, for they combine the hardiness of the Japanese yew with the pleasing deep green color of the English yew. *Taxus media* forms are available from nearly all northern growers.

*American arbor-vitae *(Thuja occidentalis)* (2). A medium-size tree of eastern North America, commonly planted here and in Europe, where it was apparently the first American tree grown (Cartier Expedition, 1534). It is variable, and about 127 forms, many of them shrubby, have been named over the years. It will grow better on moist sites than many other conifers. B, G, ME, MU, SH, W, FA-s, G-s, ME-s, SC-s, TM-s.

*Oriental arbor-vitae *(Thuja orientalis)* (6). In gardens usually a tall pyramidal shrub with foliage in vertical planes, but older specimens may be small-size trees. One popular form, 'Elegantissima', is about 25 feet tall at Brooklyn Botanic Garden after 40 years, but the species can be even taller. Long cultivated, and the date of its introduction to the West is obscure. David Hosack of New York's Elgin Botanic Garden (now the site of Rockefeller Center) grew it in the early 1800's but Oriental arbor-vitae had been in cultivation a century earlier. Oriental arbor-vitae was once placed in a separate genus, *Biota,* because of its large hooked fruits, and it is still frequently listed as such in nursery catalogs. SF, SH, FA-s, ME-s, SC-s, TM-s. Shrubby globe forms available from many nurseries.

*Giant arbor-vitae *(Thuja plicata)* (5-6). One of the most massive trees of the Pacific Northwest. The name giant is well deserved, for the girth of a buttressed trunk may occasionally be 50 feet. When grown in an open spot, giant arbor-vitae often develops into a small forest. The oldest specimen in cultivation, planted in the 1850's on the Isle of Mainau in Germany by Grand Duke Frederick of Baden, is one of the world's great trees. Menzies saw giant arbor-vitae on Vancouver Island in British Columbia in 1796, but the tree was not cultivated until about 1851 (Britain). A hardier strain from the Coeur d'Alêne mountains of northern Idaho—satisfactory for the northeastern U.S.—was found near the end of the 19th century. SF, W, FA-s, G-s, ME-s, SC-s, TM-s.

Japanese arbor-vitae *(Thuja standishii)* (5). A small or medium-sized tree from the mountains of central Japan, this arbor-vitae is often multi-stemmed. It is somewhat spreading and less stiffly formal than *T. occidentalis*. A good specimen grows at Arnold Arboretum.

English plant hunter Robert Fortune sent the tree from Japan to Standish's Nursery, Ascot, England in 1860. B, SH.

Hiba arbor-vitae *(Thujopsis dolabrata)* (6). An uncommon medium-sized tree from Japan, much like an arbor-vitae but with broader, very flattened branchlets and larger shiny leaves which are silvery beneath. A good specimen grows in the von Gimborn Arboretum, Doorn, Holland. Hiba arbor-vitae is more common in the U.S. in its dwarf form. George Rogers Hall introduced the species to the U.S. in 1861. A, B, TM-s.

Japanese torreya *(Torreya nucifera)* (5). A rare species from southern and central Japan, usually just a small tree in Western cultivation. The leaves are yew-like but are stiff and sharply pointed. A good specimen grows at the New York Botanical Garden. The genus is named for American botanist John Torrey (1796-1873). Thought to have been introduced to the West (Britain) in 1764. B, FA-s.

Common hemlock *(Tsuga canadensis)* (4). A tree which can ultimately grow to about 90 feet (but seldom in cultivation), primarily northeastern in distribution but with outreaches as far west as Minnesota and as far south as Alabama. A versatile shade-tolerant tree which can even be used for dense clipped hedges. Cultivated since early colonial times. CR, ES, ME, MU, RO, SF, VI, W, CR-s, FA-s, G-s, ME-s, SC-s.

Sargent weeping hemlock *(Tsuga canadenis* 'Pendula'; synonym, *T. c. sargentii)* (4). A beautiful spreading pendulous form. One of the trees found by General Joseph Howland in the late 1860's in the Fishkill hills of eastern New York still lives at Craig House Sanitarium, Beacon, New York. It is 15 feet high and 35 feet across. Another original tree stands in what was C.S. Sargent's garden in Brookline, Massachusetts. Other magnificent (but not original) specimens may be seen at Planting Fields Arboretum, Bayard Cutting Arboretum and the Arnold Arboretum. A fine 80-year-old specimen, given to the Brooklyn Botanic Garden several years ago by Mr. Jerome Lukins, Port Chester, New York, grows near the Administration Building. Sargent weeping hemlock is named for Henry Winthrop Sargent. A, B, ME, RA, RO, W, WFF, VI.

Carolina hemlock *(Tsuga caroliniana) (4). A tree with a small native range in the southern Appalachians. More widely planted now than formerly because of its perhaps greater adaptability to different growing conditions than *T. canadensis.* Well-grown trees are often more dense than common hemlock. Fine old specimens grow at the Arnold Arboretum, which introduced the tree to cultivation (1881). HL, ME, MU, RA, RO, W, FA-s, ME-s.

Japanese hemlock *(Tsuga diversifolia) (5). A distinct spreading hemlock, usually a small tree in cultivation. Common to the mountains of central and south Honshu in Japan. John Gould Veitch introduced the species to the West (Britain) in 1861. A, B, RA, CR-s, FA-s, G-s.

Pacific hemlock *(Tsuga heterophylla) (6). A tall hemlock from the Pacific Coast (inland to Montana), magnificent when grown under mild humid conditions. Unsatisfactory in the northeastern U.S., but in England and the Low Countries it performs better than any other hemlock. Seen by Douglas in 1826, introduced to cultivation by Jeffrey (1851). RA, CR-s, FA-s, SC-s, TM-s.

Siebold hemlock *(Tsuga sieboldii)* (5). A fine spreading small tree (in cultivation), from the mountains of southern Japan. Much like *T. diversifolia,* from which it is separated by minor botanical characteristics (yellow-brown, glabrous branchlets in *T. sieboldii;* reddish-brown hairy branchlets in *T. diversifolia*). Philipp Franz von Siebold (1796-1866), the European plant explorer for whom the tree is named, introduced it to the West (Holland) about 1850. B, HL, ME, O, RA, CR-s, FA-s.

Key for Nursery Sources

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(SC)—F. W. Schumacher, Horticulturist & Seedsman, Sandwich, Massachusetts 02563. (Primarily for nurserymen & foresters.)

(SF)—Silver Falls Nursery, Star Route 55, Silverton, Oregon 97381.

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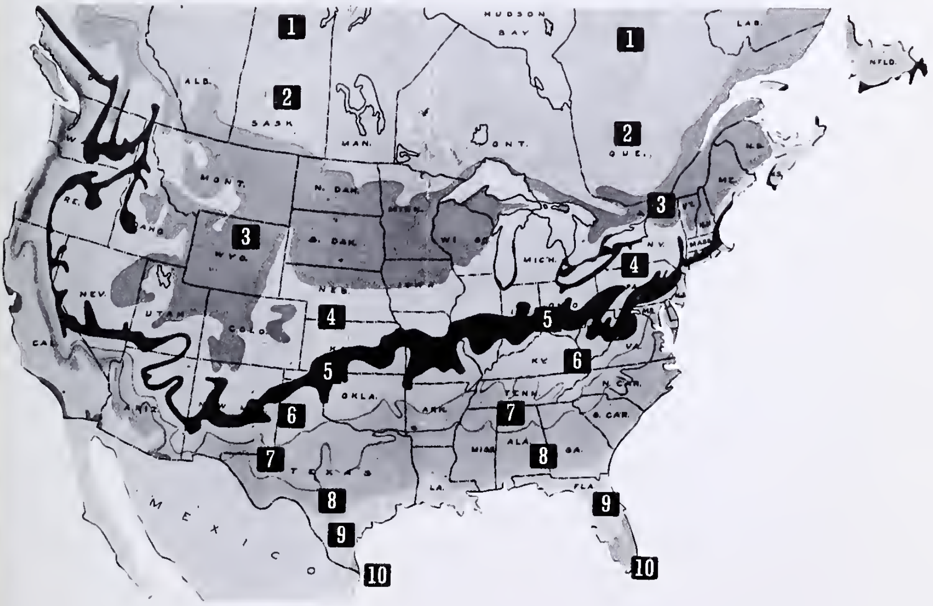

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Gardening in the Shade

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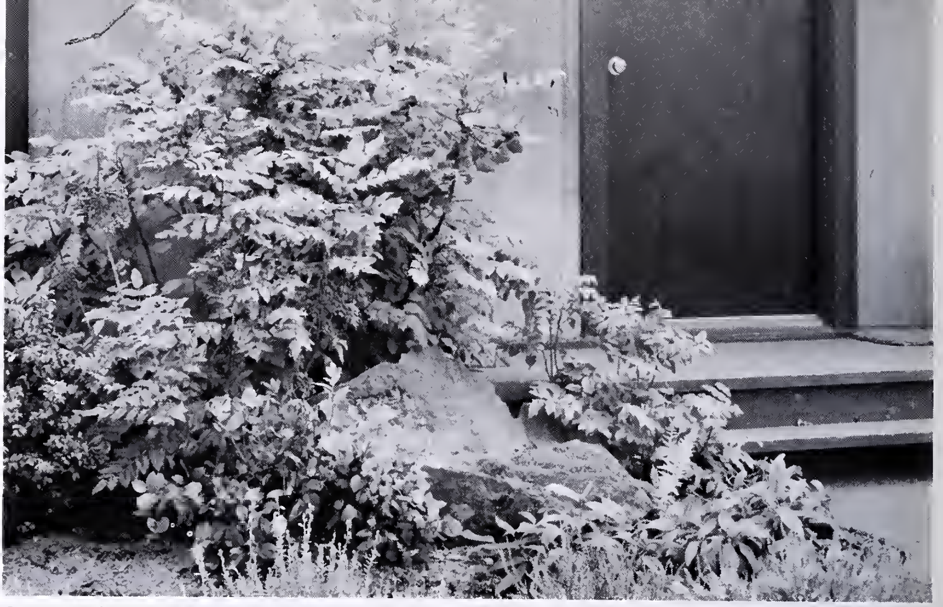

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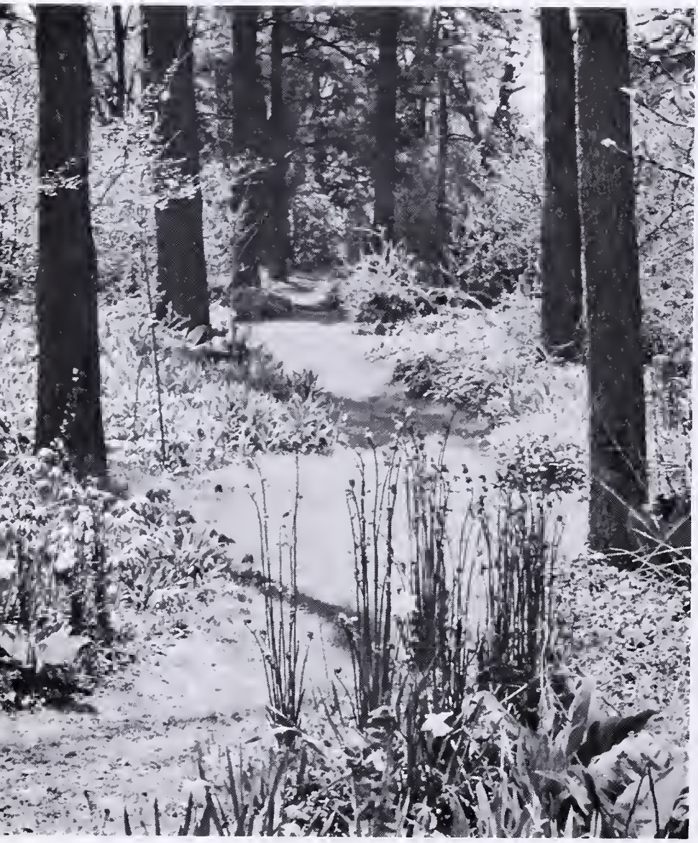


Two Aspects of Shade Gardening—*(Above)* Around a large mossy rock beside a front entrance facing north grow the leatherleaf mahonia (*Mahonia bealei*), salal (*Gaultheria shallon*), and *Viburnum davidii*. (Left) Woodland garden of wild flowers, ferns and many other kinds of plants thrive in filtered sunshine of spring. When the lower limbs of trees are removed, the increase in light permits growth of a wide variety of plants.

BROOKLYN BOTANIC GARDEN

This **PLANTS AND GARDENS** Handbook on Growing Plants in the Shade is the last special-subject handbook for the year 1969. The year-end digest issue will follow soon and will mark the end of the 25th year of publication of **PLANTS & GARDENS.** It has been a privilege to guide P & G for all these years—through the 100th issue, and some million or more copies. It is now a pleasure to think of future publication being under the guidance of my successor, Dr. Louis B. Martin. With the continued warm cooperation of the Botanic Garden's friends across the country and around the world, its Board of Governors and devoted staff, the future is bright indeed.

The pages that follow deal with growing plants in the shade, and I would like to say a few things about environmental factors and plant growth.

Of all the external influences that affect the growth of green (chlorophyll-bearing) plants, it seems safe to say that light—or lack of it—deserves the closest attention. To be sure, no plant will grow without water and adequate mineral nutrition; and no plant on earth can escape the effects of gravity. Nor can a plant be grown successfully at unusually low or unusually high temperatures. Yet we find plants growing either in or on the fringe of inhospitable deserts where both lack of water and extremes of temperature bring cultural hardship for every living thing. So, too, do we find a few green plants on the desolate Antarctic continent, and on the island of Spitsbergen a few hundred miles from the North Pole. Closer home—most kinds of plants grow with surprising vigor in the polluted air of our great cities. Life—its very essence—is at once a precious yet tenacious quality of that great and diverse category of things we say are "living." What green plants definitely cannot do is to live and grow in the absence of light.

The success of green-ness comes down to the single fact that only chlorophyll-bearing plants can trap the energy that streams from the sun. Let no man underestimate this remarkable quality of the plants that cover a goodly portion of our earth. The further fact that some plants require less light than others is not particularly surprising; it is a matter of efficiency, a built-in genetic characteristic that enables some plants to live, grow and reproduce with a minimum supply of energy from the sun. The shade-loving (or shall we call them shade-tolerant) plants that are the subject of this handbook—are only the shade-loving plants that belong in gardens, in our esthetic life. Some of them succeed happily, if one may use that word about a plant, on as little as one-tenth the light needed by sun-loving species.

Guest Editor Harold Epstein has gardened in the shade of great oaks for many years, so he writes from long experience on a subject that has interested him deeply. And the authors he has invited to collaborate with him in putting together this remarkable guide-book are also highly knowledgeable people. Mark their every word!

George S. Avery

Molly Adams

Flagstone and pachysandra are among the solutions for ground in heavy shade.

A scientist looks at shade . . .

THE ENVIRONMENT OF SHADE

Gustave A. L. Mehlquist

THE word shade, when applied to gardens and gardening, has different meaning to different people. To chrysanthemum growers, the word shade is likely to bring to mind pulling black cloth over benches or beds of plants late in the afternoon to shorten the day and thus hasten flowering. To nurserymen, the word shade may mean the reduction of light intensity on young plants or on plants just dug for sale, or it may mean the necessity of providing suitable conditions for so-called shade-loving plants. The term shade-loving is used advisedly here, for although every gardener knows that many plants in nature are found in shade, and often in shade only, there is no proof that these plants actually require shade per se.

The fact that many alpine plants in nature are found on lofty mountain peaks only in strong sunlight, but in cultivation near sea level can be grown successfully only under degrees of shade, suggests that light is not the limiting factor. At higher elevations full light intensity is rarely combined with high temperatures, but at lower elevations the same light intensity may be accompanied by very high temperatures, suggesting that temperature may be the limiting factor.

Recent innovations in cooling greenhouses are now permitting operators to grow plants under glass during the summer with much less shade than before. They are thus in effect exposing the plants to much higher light intensities than before and with unmistakably better results.

Also, many so-called shade-loving plants in gardens endure and often do better under much higher light intensities than those prevailing where the plants are growing wild. The common mountain-laurel (*Kalmia latifolia*) and many orchids are examples of this. In this case the fact that these plants in nature are usually found only in shade appears to be concerned with their reproduction. Although they may grow and flower very well in the garden, and also in nature in full sun when the tree cover is removed, there are seldom many seedlings to be seen, whereas in a shady location they may occur in abundance.

It is now well known that the distribution of a species in nature is limited by the conditions which permit reproduction, rather than the growing and flowering of mature plants. In the garden, where one starts with mature or near-mature plants, success may not only be possible but often more readily obtainable under conditions of higher light intensities, higher temperatures, or less water.

That many plants in cultivation are adapted for a more favorable climate than that in which they are found in nature is further borne out by epiphytic plants in general, and particularly those in the bromeliad and orchid families. Members of these families often grow much better under cultivation than in their natural habitat. The explanation here seems to be that only under the relatively meager conditions of the epiphytic habitat can these plants hold their own, so to speak, against other plants which under more favorable conditions would outgrow them.

Often it may be desirable to provide some shade even at the expense of a few flowers. Many rhododendron species and hybrids will produce somewhat fewer flowers in partial shade but the flowers last much longer and the colors do not fade so fast, so the net effect is that of a "better and longer show."

Shade from Trees

It has been pointed out that the shade provided by trees may be different in quality from that provided by artificial means. It is true that light filtered through a canopy of green leaves may be different in quality from that caused by a building, or coming through a screen of wood laths or other objects. It has yet to be proved that the light coming through a canopy of green leaves is really better for the plants growing beneath, but the effect certainly is usually a more pleasing one.

With this in mind one might do well to give some thought to the selection of trees which are to provide the shade. Trees which cast a very dense shade are usually less desirable than those of more open habit. Also trees with the lowest branches some distance above ground are preferable to those with branches close to the ground, as "high" branches provide a condition akin to a "moving" shade. The plants are exposed to strong light, perhaps full sunlight, for a few minutes and then shade for a few minutes, giving an alternating play of light and shadow. Some trees, such as the European beech and most maples, provide not only too dense shade, but also have very fibrous, surface root systems which provide too much competition to smaller plants for both water and nutrients. Trees which keep their leaves rather late in the autumn provide some protection against early frosts, a feature which may prolong the season of fall-blooming herbaceous plants by two or three weeks. As a protection for rhododendrons and similar plants, high-branched conifers, of course, are hard to beat.

Of course, many people do not have the opportunity to choose their trees (shade gardening is often just making-do with what one has inherited), but those who do should endeavor to select trees with deep, coarse root systems rather than fibrous surface roots. It is probably true that a plant can be found that will grow in the driest and darkest corner, but generally speaking, the plants with the showiest flowers and foliage are most readily grown where there is fairly good light and a soil relatively free from competitive roots. Partial to light shade should be the aim for, under such conditions, one can not only grow a great number of interesting plants but man, beast and fowl will be able to enjoy them. ◆

There is a wide selection among these shrubs, perhaps the most suitable for shade . . .

BROAD-LEAVED EVERGREENS

Gordon E. Jones

All photographs by Marjorie J. Dietz unless otherwise credited

Carolina rhododendrons in May with a ground cover of the blue-flowered *Vinca minor*. In or out of bloom, in various degrees of shade, they are superb shrubs for landscaping. Plants can be pinched back selectively in early summer for size control.

SHADED AREAS of the garden are frequently considered plant-selection problems by new homeowners who have not yet become acquainted with the many kinds of broad-leaved evergreen shrubs. Most of these plants demand some degree of shade, and it is safe to say that one exists for almost every kind of shade situation. Generally speaking, the shrubs with the largest leaves need or can tolerate the greatest amount of shade; the smaller-leaved shrubs need less shade and for best flowering performance need a goodly portion of sunshine during the day.

Broad-leaved evergreens include rhododendrons and evergreen azaleas, camellias and mountain-laurel, all famed for their superb flower displays in spring, as well as hollies, evergreen barberries, andromeda, and many others valued mainly for their foliage. All are outstanding candidates for the shaded garden, no matter how limited or extensive it may be. They are especially fine planted in woodlands under deciduous trees, such as oaks. Few plants flower properly in dense shade, though, and broad-leaved evergreens, especially rhododendrons planted beneath large trees, produce the most flower buds when the trees are trimmed high, so that light—even sunshine—filters through for a portion of each day.

Rhododendrons

Although there are many, many species, hybrids and varieties of the rhododendron, the native Carolina rhododendron *(Rhododendron minus,* formerly known as *R. carolinianum*) remains popular. It has neat foliage, lovely white-to-pink flowers in May, and a compact habit of growth. The plants increase in size slowly, but eventually reach 5 or 6 feet or more and nearly as wide, so this ultimate size should be kept in mind when planting them.

Some Carolina hybrids, which have smaller-leaved, dwarf species as one parent, are decidedly more compact in size and therefore more suitable for limited suburban properties. 'Dora Amateis', a recent hybrid, remains a dwarf, rich green-foliaged plant that, in early May, literally smothers itself with blooms larger and purer than those usually seen among the small-leaved rhododendrons. 'Windbeam' is another profuse-flowering Carolina hybrid. Its flowers open white and change to delicate pink. 'Wyanokie', with pure white flowers, is similar but more compact in habit, reaching only 2 to 2½ feet in ten years.

Two very different varieties developed from the Carolina rhododendron are 'Purple Gem' and 'Ramapo'. Both are dwarf and compact, and have very small gray-green leaves. Flowers are bright violet-blue. 'Purple Gem' is a little deeper in color and slightly larger.

The early yellow-flowered species from Japan, *Rhododendron keiskei,* is a welcome early spring delight and is especially suited to a shady area in the garden.

A relatively new species introduced in recent years from Japan, *Rhododendron yakusimanum,* is a slow growing, compact plant having handsome leaves with a colorful brownish-orange, feltlike indumentum on the underside of each leaf. It produces lovely apple-blossom-pink-and-white flowers in mid-May. A mature plant of this species is one of the most beautiful and highly prized specimens found in a rhododendron buff's garden.

Evergreen azaleas offer nearly as many possibilities for shade gardening as the generally larger-leaved rhododendrons. Many of the delicate pastel as well as even the strong, vibrant red and orange colors among azaleas tend to streak or fade if the plants are exposed to too many hours of direct sunshine. Many of the late spring azaleas, such as the Gumpo group and the low-growing variety 'Balsaminaeflora,' definitely need at least partial shade to prevent their flower colors from fading.

Rhododendrons and azaleas need a soil that is at least slightly acid, and prefer one which is loose, rich in organic matter, moisture-retentive but well-drained.

Mountain-laurels and Hollies

Mountain-laurel (*Kalmia latifolia*), a native shrub common throughout woodlands of eastern North America, is not only beautiful in flower in mid-June, but is a handsome evergreen plant throughout the year. Flowers vary in color from white to various shades of pink. A few nurserymen are now propagating selected plants that produce flowers unusually and strikingly deep pink, nearly approaching red in color.

Hollies are a versatile group of plants, growing under all types of conditions, including heavy shade. Many are trees, while others retain shrub growth habits. Some hollies are very hardy while others, including the English and Chinese hollies, are more tender, but are well worth trying in protected locations in the North. Among the English hollies (*Ilex aquifolium*), only the hardiest varieties are recommended for the Long Island and metropolitan areas.

'Camelliaefolia' and 'James Esson' as well as a hardy male flowering variety, 'T. H. Everett,' have proven the most satisfactory in my opinion.

A hybrid resulting from crossing *Ilex aquifolium* and *I. pernyi,* an attractive small-leaf species from China, has resulted in two outstandingly hardy ornamental hollies. Smaller in leaf size than English holly, but equally lustrous and attractive, the variety 'San José' is a prolific berry producer, the fruits persisting well into winter. 'Gable's Male,' originated by Joseph Gable in Stewartstown, Pa., is an excellent landscape plant.

The foliage of our native American holly (*Ilex opaca*) is not as glossy as the English holly but its red berries are equally attractive. The hardiest superior fruiting varieties such as 'Manig,' 'Farage,' 'Hedgeholly,' 'Miss Helen,' 'Old Heavyberry,' 'Arden' or 'Canary' which has yellow berries, are extremely attractive shrubs or small trees in any garden.

Ilex cornuta, the Chinese holly, is one of the handsomest hollies, striking because of its exceedingly glossy leaves and

'Dora Amateis' rhododendron is a recent hybrid introduction of compact habit. In full bloom, the plant is covered by the flowers; at other seasons, the light green, almost succulent foliage is an asset.

their unusual rectangular shape with prominent but limited spines. *Ilex cornuta* 'Rotunda' and the variety 'Dwarf Burford' are fine new, low-growing types. A sheltered location must be provided to prevent winter injury.

A valuable native species of the eastern United States, inkberry (*Ilex glabra*), is a light, graceful shrub, 6 to 8 feet tall, producing black berries. Its hardiness and informal habit contribute to its usefulness as a choice shrub for shady, moist locations. There is an interesting white-berried form, *I. glabra* 'Ivory Queen,' that is well worth seeking out.

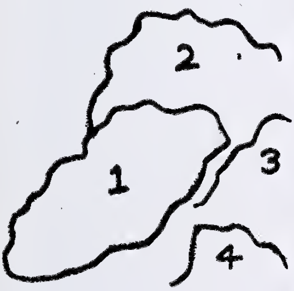
Barberries

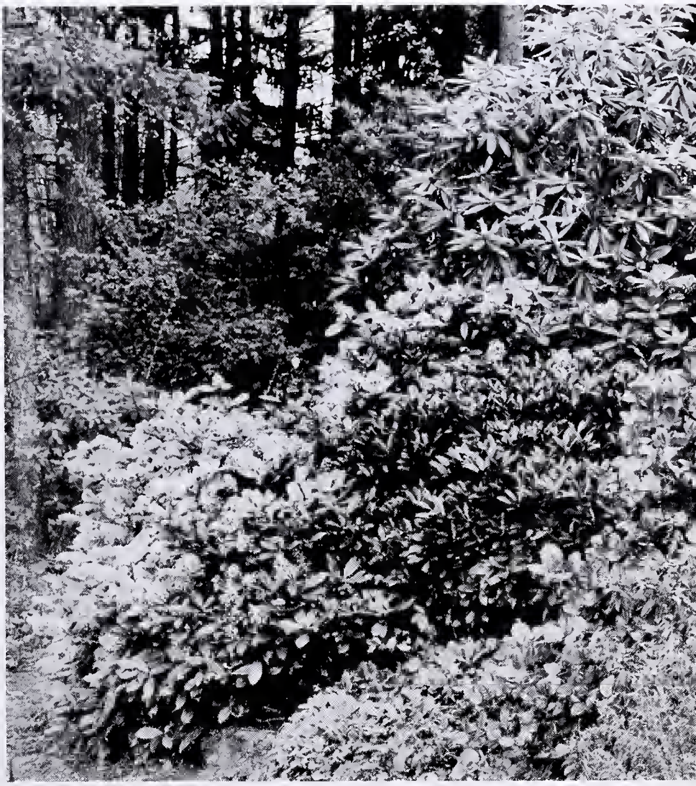
The evergreen barberries, even though armed with thorns, are excellent shrubs if kept away from edges of walks or other pedestrian traffic areas. Chenault barberry (*Berberis chenaultii*), pale-leaf barberry (*B. candidula*), and warty barberry (*B. verruculosa*) are superb evergreen shrubs. Each species develops compact, low-growing plants having interesting, leathery evergreen foliage. The leaves are white underneath and make a distinct and effective contrast with the lustrous green above. The small, golden yellow flowers in May, while not spectacular, are attractive when seen at close hand, and develop into blue-black fruits in the fall.

Andromeda

Perhaps one of the most effective and reliable evergreen shrubs in shady areas are the several forms of the Japanese andromeda (*Pieris japonica*). The nodding clusters of flower buds are interesting throughout fall and winter. They open in mid-April as attractive, waxy clear white flowers similar in size and shape to those of blueberries. The young new leaves are rich coppery-bronze in spring, later turning a lustrous deep green.

A slow-growing, compact form of





Jeannette Grossman

An assembly of broad-leaved evergreens includes (1) skimmia *(Skimmia japonica)*, (2) rhododendrons, (3) salal *(Gaultheria shallon)*. Primroses and ferns are in the foreground.

Roche

The wintergreen barberry (*Berberis julianae*) thrives in sun or shade. Hardy through Zone 5. More refined in growth habits are *Berberis gagnepainii* and *B. verruculosa*.

Japanese andromeda, (*P. japonica* 'Compacta') is available in some nurseries. The form 'Dorothy Wyckoff' develops especially large flower clusters that are pink in bud. Its foliage turns bronzy green in winter. Interesting, too, especially in shady locations is the variegated form (*P. japonica* 'Variegata').

The native mountain andromeda (*Pieris floribunda*) is more winter hardy than Japanese andromeda, but gardens often report unexplainable difficulty in establishing plants in locations which should be ideal growing sites.

When successfully established, the mountain andromeda's prolific erect flower clusters in April are most effective and make worthwhile the effort to procure and establish this handsome species.

Abelia and Mahonia

Flowering effectively from mid-summer until frost with small, white, pink-blushed tubular flowers, the glossy abelia (*Abelia grandiflora*) is a graceful, light-textured shrub useful and handsome in shaded situations. Evergreen throughout the year in Washington, D.C. and farther south, there is usually partial defoliation and tip die-back from winter injury in more northern areas. This is not a serious flaw as the roots are dependably hardy, and after any winter-injured portions are removed in spring, abelia soon begins its amazingly prolonged flower display.

Mahonias have holly-like lustrous leaves, bright yellow flowers in clusters early in May, and blue or blue-black grapelike berries in summer. The Oregon holly-grape (*Mahonia aquifolium*), a native shrub of the Pacific Northwest, is versatile and ornamental and grows especially well in partial shade. Providing shelter from winter sun and wind will help prevent browning and winter injury to the leaves, which normally turn to a lovely bronzy-purple color in the fall. Holly-grape grows 3-3½ feet in height and can be kept low and bushy by careful pruning. Plants spread by underground stolons, forming large clumps when growing conditions are favorable.

The leatherleaf mahonia (*Mahonia bealei*), introduced to this country from China, is an unusually different and striking plant with large, stiffly leathery,

George Taloumis

The native evergreen American holly (*Ilex opaca*) stands like a beacon in winter woods. Home gardeners should spray for control of leaf miner (or use a systemic).

compound leaves 12-15 inches long on erect stems, usually 4-6 feet high, occasionally taller. The stout, rigidly horizontal leaves are unique in character and provide a bold texture and appearance in the landscape. The flowers are lemon-yellow, somewhat fragrant and are borne in pyramidal clusters in early May. They are followed by bluish black, grapelike berries in summer. The leaves, unlike those of Oregon holly-grape, do not change color in the fall.

Leucothoë

Leucothoës are recommended as excellent companion shrubs among rhododendrons, andromedas, mountain laurel and other ericaceous or acid-soil plants. Drooping leucothoë (*Leucothoë fontanesiana,* formerly *L. catesbaei*) is a gracefully arching and spreading shrub normally about 3 feet high. Its lustrous dark green leaves through the summer turn a beautiful bronze in fall, and remain attractive throughout the winter unless exposed to severe drying winter winds. Its flowers in late May or early June are small, waxy-white and fragrant, hanging attractively in 3-inch racemes along the underside of the branches.

Coast leucothoë (*Leucothoë axillaris*) is much like drooping leucothoë except that it is smaller, growing to 2 feet in height at most. Its leaves are smaller and narrower, and have a fine texture. Both species are very valuable and are attractive blending shrubs in the landscape. To keep plants growing vigorously it is advisable to prune out older stems occasionally. This can well be accomplished by cutting branches when evergreen foliage is needed in flower arrangements. The bronzy foliage in fall blends beautifully with chrysanthemums.

Cherry-laurel

One of the most satisfactory evergreen shrubs for shady conditions is Schipka cherry-laurel (*Prunus laurocerasus* var. *schipkaensis*). Hardier than the species, this variety's shiny, leathery, lustrous rich green leaves add sparkle and highlights of interest in a shaded area. Horizontal in branching habit, the verdant plants are extremely attractive year-round. Its flowers are white and carried in racemes 2-5 inches long coming into bloom late in May.

Camellias

Until recent years it was believed impossible to successfully grow *Camellia japonica* plants outdoors in the Long Island and metropolitan New York area. Fortunately some varieties have been found to be fairly hardy when placed in sheltered and well-protected locations offering a microclimate favorable to these handsome shrubs. Some summer shade and protection from winter sun and wind are essential. If one is fortunate to have a favorable site it is challenging to try growing a few *Camellia japonica* varieties. Flower buds may be injured some winters, but the plants will come through often with only minor injury once established. Worth trying are the pink varieties, 'Kumasaka,' and 'Lady Clare'; 'Mathotiana' and 'Professor C. S. Sargent' are good reds; 'Purity' is a fine white variety. (*Editor's note:* A plant of 'Sweetheart', a pink *Camellia japonica* variety, which grows in East Hampton, Long Island, has suffered total winter injury to its buds in only one winter out of twelve.)

Camellia sasanqua varieties, thought once to be promising on Long Island, unfortunately, have so far not proven to be winter hardy except in Brooklyn.

Cyrilla

A native shrub of the South, leatherwood (*Cyrilla racemiflora*) is an unusually attractive semi-evergreen shrub having pendulous clusters of small white flowers late in June or July. It is particularly distinctive and most striking in its brilliant orange and scarlet foliage color in autumn. Not commonly found in nurseries and garden centers in the New York area, it nonetheless should be sought as an interesting and worthwhile plant for shady garden areas. It requires a soil rich in humus and one that retains moisture.

A Low Evergreen

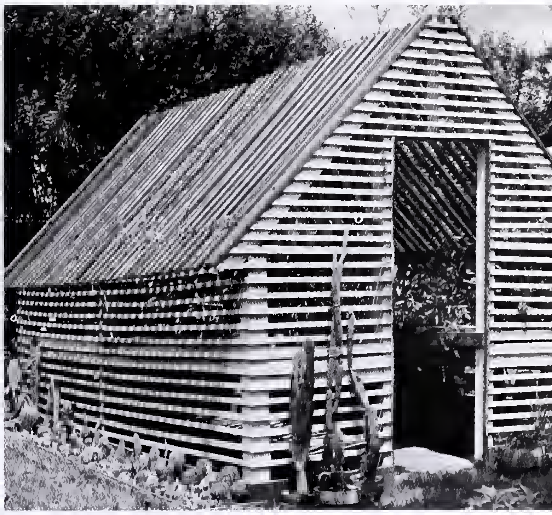
Last, though it should hardly be considered insignificant, is the low-growing *Pachistima canbyi,* a native of eastern North American woodlands. It is an evergreen, its needle-like leaves measuring less than 1 inch in length. The plants are shrubby, rarely exceeding a height of 12 inches. Although they spread by underground runners to form a fairly dense ground cover in shade, the effect is always tidy. The spelling of the generic name has been recently changed to *Paxistima.*◆

MOSS gardens are relatively rare in this country, but a notable one exists in the Japanese garden in Portland, Oregon. Even in the favorably moist Oregon climate an automatic fogging system has been found necessary for the best growth of the mosses. The Japanese have always appreciated the beauty of mosses, and the art of moss gardening has reached high development in their country. The greater use of moss has a future in western-style gardens. Most mosses are very beautiful, and are nature's own plant selections for various shady situations. They are worth a trial, especially in shaded rock gardens and near pools. (*At left:* Introduction of mosses on rock outcropping in Epstein garden.)

Marjorie Dietz

Man-made shade . . .

LATH SHELTERS

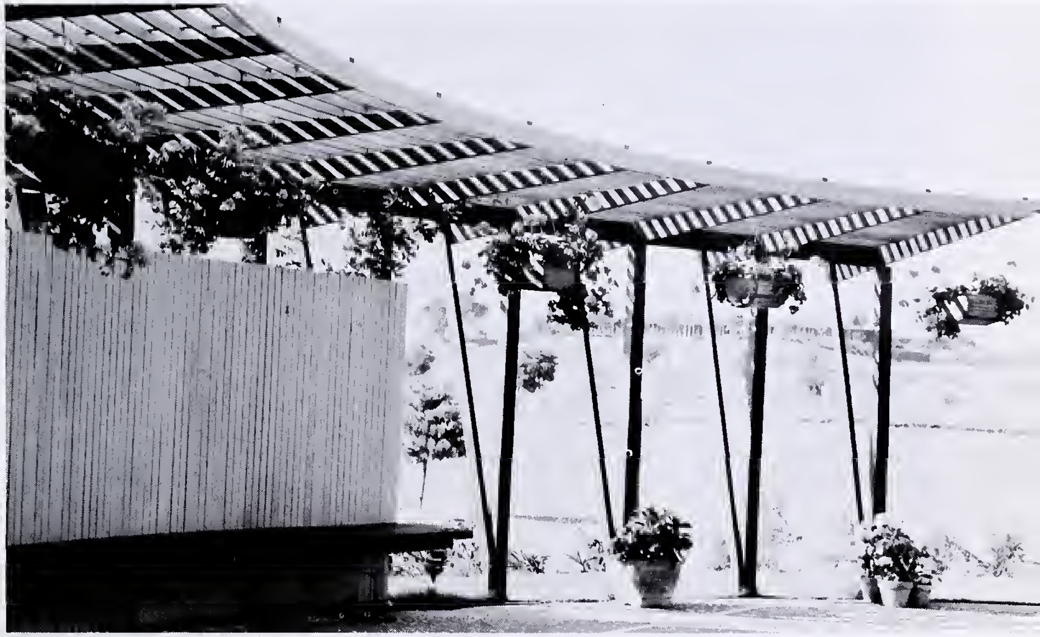


Roche

Lath house shades orchids in summer.

Roche

Functional lath structures for camellias.



George Taloumis

Plants in hanging baskets prosper in the partial shade of this contemporary structure. Home gardeners can construct elaborate or fairly simple lath shelters.

Flowering and berry-bearing deciduous

SHRUBS FOR SHADY PLACES

Herman S. Porter

Roche

The pinxterbloom azalea (*Rhododendron nudiflorum*) is a fine shrub for partial shade. It loses its foliage in winter. Its pink flowers appear in late April or May.

MUCH OF THE BEAUTY of our landscapes is created by contrasts of light and shadow as they are filtered over lawn and garden. And deciduous shrubs can be a part of these patterns, although under the most difficult conditions of shade gardening, certain shrubs may have to be tried on a win-or-lose basis.

The amount of shade that shrubs must endure in a given location is not usually the only obstacle that they face. Often there is the question of root competition from existing trees such as beech, Norway or sugar maple, which have such dense surface root systems that only the strongest rooted shrubs can survive. More often, it is a matter of soil—its structure and organic composition, its pH, its moisture-holding capacity in relation to the needs of the plant. Before planting any deciduous shrubs in shady situations, such existing conditions should be considered.

Most gardeners want seasonal changes in their shrubs: flowers in spring, summer or autumn; appealing foliage all through the growing season and, preferably, delightful autumn coloration. In winter, they wish to see a plant with interesting form, bark or twigs that please the eye, and showy fruit that attracts winter birds. Obviously, few plants can furnish all these desirable characteristics, especially shrubs that will grow in the shade. Compromises must be made.

Too often shrubs are planted and forgotten. Shrubs are kept at their best by being given attention frequently. It is difficult to restore shrubs to their original beauty after neglect. Shrubs grown in the shade prove this rule rather than being its exception.

Shrubs in the shade require pruning to keep them within bounds and to maintain their beauty of form, feeding to help keep them healthy and luxuriant in appearance, and spraying or dusting to protect them from insects and diseases—the same as other plants. Watering is especially important during periods of drought when tree roots and shrub roots must compete for the small amount of water available.

Among deciduous shrubs there are just a few that will thrive in dense shade. However, the number that will tolerate moderate-to-light shade is considerably greater. The following deciduous shrubs will grow in varying degrees of shade. Those best adapted to dense shade are indicated by an asterisk (*). Zones are those of Arnold Arboretum Zone Map (1967).

**Abelia grandiflora* (Glossy Abelia) 5–6 feet. A semi-evergreen shrub with small, glossy dark green leaves. Flowers white, flushed pink from June to September. Two dwarf forms, 'Edward Goucher' and 'Sherwoodii' are available. Both have flowers deeper pink than the species. Zone 6 to 5B.

**Abeliophyllum distichum* (Korean Abelia-leaf. Often called white-forsythia) 3–5 feet. White flowers along stems appear before leaves in late April and May. Moderate to light shade. Zone 5.

**Aronia arbutifolia* (Red Chokeberry) 5–6 feet. Attractive, abundant red berries persist through the winter. Red foliage in autumn. Growth habit irregular. Tolerates moist soil. Zone 4.

Aronia melanocarpa (Black Chokeberry) 3–4 feet. Leaves light green. Fruit glossy black. Foliage purple in autumn. Shapely plant for use in border. Tolerates moist soil. Zone 4.

Azalea See *Rhododendron.*

**Berberis thunbergii* (Japanese Barberry)—4–5 feet. Bright green leaves which turn red in autumn. Bright red berries persist through most of winter. A dwarf form 'Minor' is one of several available selections. Zone 5.

Callicarpa dichotoma (Korean Jewel-berry)—4–5 feet. A plant highly prized for its abundant violet-lavender berries which appear in late summer. Zone 5 to 4B.

Callicarpa japonica (Japanese Jewel-berry)—4 feet. Showy violet berries in October. Zone 5.

Ceanothus delilianus (Ceanothus) — 4–5 feet. Tender. Semi-evergreen. Flowers shaded to deep blue. Plant in protected locations. Zone 6.

Chamaedaphne calyculata (Leatherleaf)—1–3 feet. Semi-evergreen. Needs a moist, acid soil. Zone 3.

(*Continued*)

Dwarf fothergilla's brushlike flowers.

Roche

Small yet abundant flowers of blueberry.

Clethra alnifolia (Sweet Pepperbush)—3–6 feet. Very fragrant, abundant white-racemed flowers in summer. Zone 3.

Cotoneaster dammeri (Bearberry Cotoneaster)—6–8 inches. A prostrate semi-evergreen shrub that makes an excellent ground cover. Red berries in autumn. Zone 5.

Cotoneaster dielsiana (Diel's Cotoneaster)—5–6 feet. An attractive arching shrub with red berries and small glossy dark green leaves which turn red in autumn. Zone 5.

**Diervilla sessilifolia* (Bush-honeysuckle)—3–4 feet. A yellow-flowered shrub closely related to and resembling weigela. Well adapted to shady places. Zone 4.

Enkianthus campanulatus (Redvein Enkianthus)—6–20 feet. Choice shrub in heath family bearing cream or yellow flower bells with red veins in late spring. Branches in tiers. Foliage turns red and orange in fall. Fine companion for azaleas. Zone 5.

Enkianthus perulatus (White Enkianthus)—5–6 feet. An attractive and early blooming shrub with white bell-shaped flowers. Upright habit. Zone 5.

Fothergilla gardenii (Dwarf Fothergilla)—3–5 feet. Interesting shrub that produces showy blooms of white spiked flowers in May. Leaves turn from yellow to orange in autumn. A worthy plant for any lightly shaded garden. Zone 5.

Hamamelis japonica (Japanese Witch-hazel)—6–15 feet. Midwinter flowers with yellow, twisted petals. Mild fragrance. Moderate shade. Zone 5.

Hamamelis mollis (Chinese Witch-hazel)—6–20 feet. As sensational as preceding species because of its fragrant winter flowers, usually from mid-January through February in New York City area. Zone 5.

Hamamelis virginiana (Common Witch-hazel)—6–8 feet. Bright yellow flowers in autumn at same time the leaves turn yellow. Less showy than preceding two species. Zone 4.

Hydrangea arborescens 'Grandiflora' (Hills-of-Snow)—3–5 feet. Mid-summer show from rounded heads of white flowers. Zone 4.

Hydrangea quercifolia (Oakleaf Hydrangea)—3–4 feet. Interesting foliage. Large panicles of white flowers in late spring. Withstands moderate shade. Zone 5.

Hypericum calycinum (St. Johnswort)—1 foot. Almost evergreen with very deep green leaves. Exceedingly bright yellow flowers 2–3 inches across during summer months. Zone 5 to 4B.

Ilex verticillata (Black-alder)—5–6 feet. Highly desirable shrub with red berries that persist through much of the winter. Female plants bear berries but male pollinator is needed. Zone 3.

**Ligustrum obtusifolium* 'Regelianum' (Regal Privet)—5–6 feet. Used largely

Roche

Abelia blooms from June to frost.

Roche

Oakleaf hydrangea grows in sun or shade.

because of its good foliage and ability to withstand heavy shade. Zone 5.

Rhododendron—(Azalea) Deciduous azaleas have requirements similar to those of the evergreen species and do well in moderate shade if planted in an acid soil containing ample organic material. Most will live, though they will not flower as well, in dense shade. Among them are the following species (there are numerous hybrids and named varieties derived from them):

	Considered Hardy to Zone
R. arborescens	4
R. calendulaceum	5
R. japonicum	5
R. molle	5
R. mucronulatum	4
R. nudiflorum	3
R. roseum	3
R. schlippenbachii	4
R. vaseyi	4
R. viscosum	3

Rhodotypos scandens (Jetbead)—4 feet. Large (2-inch) white flowers in May and June followed by shiny black fruits that stay on all winter. Zone 4.

Stephanandra incisa 'Crispa' (Cutleaf Stephanandra)—3–4 feet. An interesting, beautiful spreading shrub with deeply cut leaves of distinctive habit. Greenish-white flowers in June and its orange-reddish color in autumn make it even more appealing. Zone 6 to 5B.

**Symphoricarpos albus laevigatus* (Snowberry)—4–5 feet. An excellent shrub for dense shade. Tiny pink flowers in summer followed by large white juicy berries in autumn. Zone 3.

Symphoricarpos chenaultii (Chenault Coralberry)—3–4 feet. A highly desirable shrub for the front of the border. Bears pinkish berries in late summer and autumn. Not as well adapted to heavy shade as the previous mentioned species, but it will withstand moderate shade. Zone 5.

Vaccinium corymbosum (Highbush Blueberry)—6–8 feet. A desirable shrub in the garden. An abundance of small but conspicuous white-to-pinkish flowers in the spring, followed by delicious blueberries in summer. Leaves turn brilliant orange-scarlet in autumn. Zone 3.

**Viburnum acerifolium* (Dockmackie)—4–5 feet. A distinctive shrub that will take more than the average amount of shade. White flowers in cymes in early June followed by fruit which is red at first and then turns black. Zone 3.

Viburnum dilatatum (Linden Viburnum)—6–7 feet. Dark green foliage. Creamy-white flowers in late May or early June followed by deep crimson berries in autumn. Withstands moderate shade. Zone 5.

DWARF CONIFERS FOR SHADE? OF COURSE!

Joel W. Spingarn

THE SHADY GARDEN need not omit these aristocrats of the plant world. Dwarf conifers too often are absent because they are usually categorized as sun lovers, but while it may not be common knowledge, there are a number of fine, shade-tolerant conifers available. They are rare, but with a bit of searching, can be found at specialized nurseries.

Without doubt, there is no single type of plant that imparts as much enjoyment, year long, for the space it occupies. The one prerequisite—an aesthetic one—for the effective use of dwarf conifers in the shady garden is the observance of scale. It may be difficult to meet this requirement when one's projected garden area is surrounded by large, shade-casting plants. The dwarf conifer would appear absurd if planted among majestic, towering trees, in turn underplanted with giant broadleaved evergreens, but if a dwarf conifer or a group of dwarf conifers (dwarf conifers are excellent grouped together) is used as an integral part of a small garden within the framework of the larger garden containing the massive, shade-casting plants, it would then be in scale with its immediate neighbors. The small garden, in its entirety, then becomes large enough to be congruous and in scale with the whole landscape.

Dwarf conifers also belong in the shady rock garden around pools, or among groupings of low-growing plants. The effect is quite charming when the contrast in foliage texture is achieved by associating them with low-growing herbaceous material as well as with other woody plants such as dwarf alpine rhododendrons, azaleas and daphne. Floral displays are immeasurably enhanced by using needle evergreens as a foil. In addition, the presence of these plants stirs the interest of visitors. The perfection of their beauty brings an aura of "expertness" to the garden scene. Give these plants a suitable setting and background, and you will be well on the way to accomplishing a work of garden art, which, after all, is the ultimate end to any endeavor that includes planning and design.

The following kinds of conifers have been tried and are recommended for varying degrees of shade, as noted. It is advisable before growing the forms of *Chamaecyparis obtusa* and *Cryptomeria japonica* in areas of temperature extremes to check private and/or public gardens locally to determine plant hardiness. However, all of the following are hardy on the South Shore of Long Island.

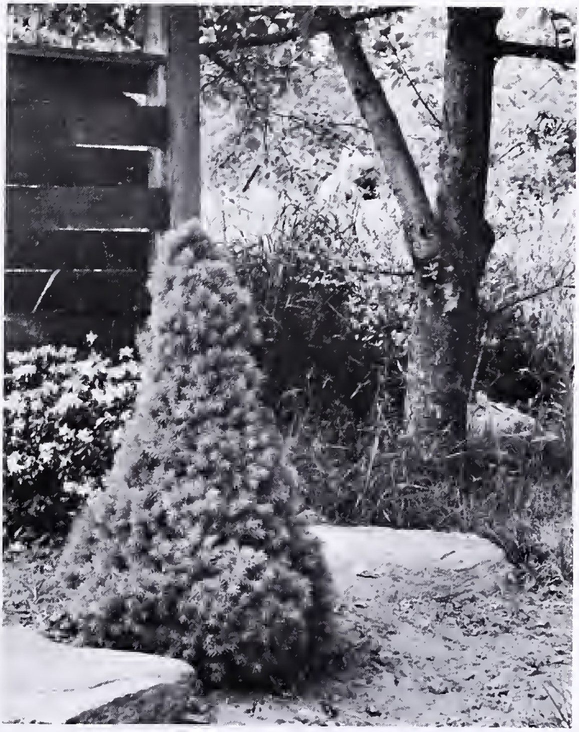
Key. The number after the plant name represents the degree of shade tolerance: FULL SHADE 1; THREE QUARTERS 2; HALF 3. Letter or letters after the plant name represent its outline as follows:

PROSTRATE-CREEPING A; REPANDENT (SPREADING) B; SUB-GLOBOSE C; GLOBOSE TO LOW PYRAMID D; CONICAL E; FLAT TOP —HORIZONTALLY BRANCHED F; IRREGULAR G. The addition of an asterisk* denotes a pygmy form with an annual growth of an inch or less.

Chamaecyparis obtusa

'Bassett'	3C*
'Chilworth'	3C*
'Compressa'	3C*
'Contorta'	3DG
'Densa'	3C*
'Flabelliformis'	3C*
'Gracilis Nana'	3EG
'Intermedia'	3C*
'Mariesii'	3D
'Nana'	3C*
'Nana compacta'	3EG
'Kosteri'	3D
'Repens'	3B
'Rezek Dwarf'	3C*
'Spiralis'	3E*
'Stoneham'	3C*

(*Continued*)



Right: The Alberta spruce (*Picea glauca* 'Albertiana Conica') grows in high or partial shade. *Below:* A spreading form of dwarf spruce shows new needle growth under the high shade of an oak.

Cryptomeria japonica

'Compressa'	3D*
'Globosa nana'	3C
'Knaptonensis'	3D
'Mejiro-sugi'	3D
'Nana Albospica'	3D
'Pygmaea'	3D
'Sekkan-sugi'	3E
'Spiralis'	3B
'Spiraliter Falcata'	3E
'Tansu'	3D*
'Vilmoriniana'	3D*
'Yatsubusa'	3D*

Picea abies

'Clanbrassiliana'	3C
'Clanbrassiliana Stricta'	3E
'Gregoryana'	3C
'Minima'	3C
'Procumbens'	3B
'Repens'	3B

Picea glauca

'Albertiana Conica'	E ..3

Thujopsis dolobrata

'Nana'	1B

Tsuga canadensis

'Bennett'	3F
'Cole' ('Cole's Prostrate')	1A
'Cole' (Sport)	2D
'Curly'	3G
'Dwarf Pyramid'	2D*
'Fantana'	3F
'Frosty'	1D
'Horsford'	2D*
'Jervis'	3E*
'Minuta'	3C*
'Nana'	2D
'Ruggii'	3D

Marjorie Dietz

As all hemlocks are shade tolerant, dwarf varieties are especially useful in partially shaded rock gardens, near steps, or in the foreground of groupings of rhododendrons and other shrubs. Plant above is *Tsuga* 'Minuta,' a very dwarf hemlock.

Hardly a shade-loving bulb—yet often, daffodils are part of the shaded garden

THE LIGHT REQUIREMENTS OF DAFFODILS

George S. Lee, Jr.

DAFFODILS are definitely not shade-loving plants and it is really not accurate to describe them even as shade-tolerant plants. (We might as well agree to call them all daffodils which is their common and correct popular name. Only when mentioning species will we speak of "narcissus," which is the botanical name [*Narcissus*]. This distinction is recommended by the American Daffodil Society.) In the wild they grow in the mountains of Spain, Portugal and northern Africa where the winters are cold and the summers hot and dry. The fact is that, as with many of the spring bulbs, shade is a condition with which daffodils have not had very much experience. The brief part of their life cycle which is spent above ground draws to a close as the new growth appears on trees and shrubs. By the time the leaves of woody plants unfold, the embryonic flowers have been formed for another year, the scales of the bulbs are packed with starch in anticipation of dormancy, and the foliage becomes limp and brown. Another year in the life of the bulb has come to an end.

While daffodils will grow in association with deciduous woody plants, they will not long survive beneath broad-leaved or coniferous evergreens. They must flower and mature in sunlight screened by nothing more opaque than the bare framework of deciduous shrubs and trees.

Most gardeners are familiar with the fact that the foliage of daffodils must be permitted to ripen and die before it is cut if the bulb is to endure. But the maturing bulbs may be subject to two other crippling conditions. The presence of nearby trees suggests the competition of roots. The severity of this competition for nourishment and moisture will depend on distance, and whether the trees are deeply rooted as in the case of the oaks, or whether they are shallow rooted as is true with beeches and maples. Bulbs may be planted rather close to the trunks of oak trees, but when it is known that the roots lie close to the surface, it is better not to plant within the drip line of the tree. A little test digging will reveal the presence of tree roots, and if they are numerous the gardener should be prepared to give supplementary feeding to the bulbs and occasionally to girdle the pocket or bed to cut off the new growth of roots which will be attracted by the richer soil.

Tidy gardeners are unhappy with the drying foliage of daffodils, brief as the period is, and try to conceal the evidence or divert attention by other plantings, including groundcovers. The reaction of the bulbs to this interference with the fulfillment of their natural life processes will depend on several factors: the competition for food and moisture, the height of the screening plants, and whether they are evergreen. Pachysandra is a very common all-purpose plant for shade, but daffodils will not long survive its competition. Its roots and underground runners range widely and deeply and it is a heavy feeder. Above ground the growth of an established planting of pachysandra will be almost as tall as the daffodil stems and effectively serves to shade the daffodil leaves from the light they must have. The competition of English ivy and myrtle is somewhat less severe, but nevertheless it is there and the struggle for survival will eventually become evident. These three ground cover plants are all evergreen and cannot fail to cut off vital light from the daffodils.

While two plants cannot feed in the

Daffodils thrive in this woodland open to sun in spring but later shaded by oaks.

same area without competition and a resulting unfavorable effect on the weaker of the two, daffodils will tolerate some groundcovers if they are deciduous, shallow-rooted, and low-growing. Even at that it may be necessary to thin the covering occasionally to permit the new shoots to break through. Acceptable groundcovers would be *Phlox stolonifera, Tiarella cordifolia* (foam-flower), *Mazus reptans* and *Asperula odorata.*

Oddly enough, two groups of daffodils —the reds or pinks and the reversed bicolors—have opposite needs in regard to protection from or exposure to strong light. Nearly all of the red, orange, or pink coloring in daffodil varieties has been derived from *Narcissus poeticus poetarum*, a poets narcissus with a small cup stained deep red, or from *N. pseudonarcissus alpestris,* which, strangely enough, is pure white. In their hybrids the coloring tends to be unstable and bleaching of the red element is not uncommon. The degree will be influenced by many factors, such as location, variety, and exposure. Reds and pinks are less affected in England and the Pacific Northwest than they are in areas where the sun is stronger. 'Rustom Pasha' is relatively colorfast, but 'Lady Kesteven' will burn within a few hours after the sun has reached it. Improvement is gradually being made, but in general flowers with red, orange, or pink coloring especially where the color is confined to a narrow band on the cup, should be cut rather promptly after opening if the flower is to be used for exhibition or decoration where full strength of the color is important.

On the other hand, the reversed bicolors which have become so popular as a result of the work of Grant E. Mitsch of Canby, Oregon, require a good deal of strong light to achieve good color effect. To be classified as a reversed bicolor, the flower must have a colored perianth—usually yellow—and the corona (cup or trumpet) should be white. But in fact the

Molly Adams

Clumps of daffodils spill color down a slope which is shaded by a large beech tree.

corona invariably opens with some degree of coloring which can be eliminated through bleaching, and this requires exposure to strong light, sometimes over a period of several days. Even then the perfect contrast of colored perianth and white corona may not be completely achieved. Manipulating and stabilizing the color characteristics is not easy.

Another daffodil trait in relation to source of light—and one with which many gardeners are not familiar—is that the open flower tends to face the strongest light. So it is not uncommon that bulbs, otherwise carefully planted, will produce flowers which turn their backs on the viewer. Normally this humor of the flower can be considered in advance of planting the bulbs; if not, the flowers will give their decision at blooming time and it may not be quite what one expected!

One final effect of the intensity of light upon this daffodil concerns the time of flowering, and this effect may be used to extend the blooming period considerably. The first daffodils, and they may be had in the New York area by mid-March, may be obtained by planting early varieties in the warmer parts of the garden. These spots may be located by observing where the snow melts first. This usually results from unbroken light, a slope facing the sun, or a background which reflects heat, such as a house or wall. Conversely, the ending of the flowering season may be delayed by planting late varieties where the snow lingers. This means a barrier between the sun and the frozen ground, such as a stone wall, evergreen trees, or a building. Varieties for early and late flowering are suggested below.

It is likely that some varieties of daffodils are less tolerant of shaded situations than others, but there is little testimony on the question. Commercial plantings are invariably in full sun to obtain maximum growth, and the extensive research in connection with the commercial production of bulbs, which is carried on in England, Holland, and the Pacific

Northwest, has not included the effects of shade. It is known that 'King Alfred,' the most widely grown of any daffodil, does not flower well except in full sun and the same seems to be true of 'Carlton,' another widely grown variety. While nearly all daffodils will perform satisfactorily when grown in association with deciduous trees, failure to flower well, if it is not obviously due to overcrowding and the need to divide a clump, can often be corrected by placing bulbs in a sunnier location. Daffodils are not gross feeders, but poor soil, the competition of tree roots, and the shortened period for ripening which trees create, all suggest generous annual feeding. Commercial bulb fertilizers are satisfactory, but expensive. Equally good results can be obtained from potato fertilizers which are obtainable from farm suppliers in rural areas. A high content of potash is the critical factor and a good mix can be made at home from more or less equal parts of superphosphate or bone meal, and unleached fireplace ashes, the latter supplying the potash.

Gardeners who are not familiar with variety names will find any of the following both high in quality and moderate in price. The grouping is according to the official classification of the Royal Horticultural Society and covers the entire range of varieties. Early varieties are identified by (E), late, by (L).

Daffodil bulbs need not be expensive and may be bought from local suppliers who usually carry the vigorous Dutch garden varieties or by mail from catalog dealers. The latter often carry a wider range of both garden and exhibition types, which may be either expensive or moderately priced, depending on how long the variety has been on the market. A prize-winning variety which may have been introduced fifteen years ago for $25 a bulb may now be available for 45¢.

Trumpets
- 1a, yellow—Arctic Gold, Grapefruit (E), Kingscourt, Unsurpassable
- 1b, white and yellow—Content, Effective, Preamble, Trousseau (E)
- 1c, white—Ardclinis, Beersheba, Mount Hood
- 1d, yellow and white—Spellbinder

Large Cups
- 2a, yellow—Carlton (E), Galway (E), Golden Torch
- 2a, yellow and orange or red—Armada (E), Ceylon (E), Fortune (E), Narvik
- 2b, white and yellow—Daisy Schäffer, Duke of Windsor, Polindra
- 2b, white and orange or red—Kilworth, Selma Lagerlöf, Semper Avanti
- 2c, white—Ludlow, Truth (E)
- 2d, yellow and white—Binkie

Small Cups
- 3a, yellow and orange or red—Ardour, Ballysillan (E), Edward Buxton, Chungking
- 3b, white and yellow—Angeline, Bithynia (L)
- 3b, white and orange or red—Blarney (L), Kanasa, La Riante
- 3c, white—Bryher (L), Chinese White, Cushendall (L)

Doubles
- 4—Gay Time, White Lion, Yellow Cheerfulness (L)

Triandus Hybrids
- 5a, large cup—Thalia, Tresamble, Rippling Waters
- 5b, small cup—Dawn, Thoughtful (L)

Cyclamineus Hybrids
- 6a, large cup—Charity May, Dove Wings, February Gold (E)
- 6b, small cup—Beryl

Jonquil Hybrids
- 7a, large cup—Golden Goblet, Sweetness
- 7b, small cup—Chérie, Tittle Tattle (L), Trevithian

Tazetta Hybrids
- 8—Geranium, Martha Washington, Scarlet Gem

Poeticus Hybrids
- 9—Actaea, Cantabile (L)

Species
- 10—*N. asturiensis, N. jonquilla, N. rupicola*

Split-Corona Daffodils
- 11—Evolution, Gold Collar, Split ◆

HARDY BULBS FOR THREE SEASONS OF COLOR

Depending on the amount and kind of shade, there is a bulb to fill every need

Gertrude S. Wister

ALL THE HARDY BULBS (and some are technically corms or tubers), I consider here, must have a fair amount of sun or light during the time when their foliage is in active growth. They are of value for those places that have light during the winter and spring, until leaves are well grown on deciduous trees and shrubs. They are not for thick plantings of evergreens where little light penetrates. Nor will they thrive under such trees as Norway maples and horse-chestnuts, which have heavy crowns of foliage and masses of surface roots. But they will grow where they are shaded by a building if there is good reflected light from open sky.

In addition to their light requirements, these bulbs need well-drained, reasonably fertile soil. It is a good idea to have their locations marked to keep the bulbs from unintentional injury while they are dormant.

Most of the bulbs are small and of great value in bringing spring to the garden or woodland early. (Daffodils appear in a separate article on page 21.) I have grouped them according to their approximate bloom season, so the same genus sometimes appears in more than one seasonal grouping. South of Philadelphia, these groups are stretched farther apart, and farther north, they tend to be pushed closer together.

Earliest to Bloom

These welcome flowers can be used in wooded areas, among shrubs, and under small, flowering trees. A south-facing slope or a spot by a house wall that catches winter sun, no matter how shady in summer, will bring them out as early as late January, but late February and March is their usual time in the Philadelphia area.

Crocuses: Crocus species are smaller in flower than the well-known Dutch crocuses. There are many that bloom in spring; I have room to mention but three. Rodents (mice, rabbits) love them. Planting the bulbs close to the stems of deciduous shrubs gives them something of a buffer from rabbits. Cover the corms about 2 inches.

Crocus chrysanthus. 4 inches. Golden rounded flowers. There are many fine varieties.

Crocus sieberi. 4 inches. Plump flowers of medium violet. Vigorous.

Crocus tomasinianus. 4 inches. Slender, pale lilac flowers, deeper colored within. Indispensable for its ability to increase by seed and offsets, thus keeping ahead of the rodents. Also good are its varieties 'Barr's Purple' and 'Taplow Ruby'.

Snowdrops: The white pendent flowers, one to a stem, give a good contrast to crocuses. Long-lived, increasing into large clumps. Cover about 2 inches.

Galanthus elwesii. Giant Snowdrop. 8 inches. Earlier than the common snowdrop, with larger leaves and flowers, though hardly a giant.

Galanthus nivalis. Common Snowdrop. 5 inches. Thrives in light woodlands. These two snowdrops are so easy and permanent they should be used by the hundred.

Winter-aconite: Like short-stemmed, bright yellow buttercups with finely cut leaves. Buy only in late summer or early fall (unless freshly dug plants can be obtained) as the tubers become drier, harder and weaker the longer they are out of the ground. Soak for twenty-four hours, plant immediately, and keep ground moist for their first autumn. Cover 2 to 3 inches.

Eranthis hyemalis. 4 inches. This common species of winter-aconite seeds freely. The flowers are about an inch across. 'Tubergenii', 'Tubergen's Glory' and 'Guinea Gold' are sterile hybrids that bloom a little later with larger, more deeply colored flowers.

Mid-spring

Here there is an overlap with the earliest, and perhaps some bulbs should be in that group. The division into blooming seasons is only approximate. In general, March is the month of the earliest group in the Philadelphia area; April is the month of this group.

Anemones: Windflowers. Like winter-aconite, they belong to the buttercup family, but look more like daisies with pretty, finely cut foliage. They require early purchase, twenty-four-hour soaking in water, and prompt planting in soil kept damp their first season. Cover 2 inches. They are grateful for summer shade, and seed freely in light woodlands. Best shielded from north winds.

Anemone apennina. 7 inches. Soft blue-violet. Increases well.

Anemone blanda. 5 inches. A little earlier, with flowers a little larger (almost 2 inches across) in blue-violet. Also to be had in white and pink. Blooms freely; seeds widely.

Chionodoxa: Glory-of-the-Snow. Hardy and dependable; bulbs increase freely. Keep species well separated from each other if their identities are to be maintained, as they hybridize readily. Cover 2 or 3 inches.

Chionodoxa sardensis. 4 to 5 inches. About six starry flowers about an inch across to a stem, soft, bright blue-violet with a white eye. There is a fine white form.

Chionodoxa luciliae. 4 to 5 inches. More slender than *C. gigantea.* A loose spike of up to ten flowers, soft, bright, blue-violet, somewhat variable, with white center. Graceful, prolific, utterly charming. An indispensable.

Chionodoxa sardensis. 4 to 5 inches. Up to six or more small flowers of intensely bright violet-blue flowers, tiny white eye.

Dutch Crocuses: Well known, in their color range of white, yellow, and deep violet to lavender blues. Like the crocus species, they can be used among shrubs and flowering trees. They do not seem as appropriate for woodland gardens.

Erythronium: Adder's-tongue, Dogtooth-violet, Trout-lily. 6 to 12 inches. Not easy. One to several pendent flowers to a stem, like small Turkscap lilies, in white, cream yellow, rose, pink or lilac. Some have handsomely mottled leaves. They need light to medium shade, and soil rich in humus, well drained, but not subject to drying out. Plant immediately; cover 3 inches.

Iris: The small bulbous iris need good drainage, winter-wind protection, and a site that is apt to be dry in summer. Cover 3 inches.

Iris reticulata. 5 inches. Deep violet flowers. Not every garden suits it, but when it is pleased, it increases well. There are a number of hybrids and varieties from light violet-blue to deep red-purple.

Puschkinia: *Puschkinia scilloides.* 6 inches. Eight or more starry flowers to a stem, looking like a small hyacinth. White with blue lines. Prefers summer shade.

Scilla: Squill. 4 to 6 inches. Hardy and indispensable. Bulbs, which increase well, are quite permanent. Cover 2 inches.

Scilla bifolia. Perhaps should be in earlier group. Rather starry and wispy, chiefly in tints of violet-blue, but there are pink and white varieties. Seeds freely.

Scilla sibirica. Intense violet-blue; not quite a true blue. Three to five drooping flowers to a stem. Worth trying under trees where nothing else will grow. It may become necessary to weed seedlings out of other small plants. There is a good white form. The sterile 'Spring Beauty' is taller and a little more violet.

Molly Adams

Snowdrops *(Galanthus)* are among the earliest of the little spring bulbs.

(Continued)

Late Spring

Summer Snowflake: *Leucojum aestivum.* 10 inches. About five green-tipped white bells spray out from the top of the stem. The variety 'Gravetye' is taller, with larger bells about three-quarters of an inch across. Long-lived.

Wood-hyacinths or Wood Bluebells. Usually listed under *Scilla,* but correct generic name now is *Endymion.* A fine group, handicapped by name problems. Especially good in medium shade. Bulbs increase well, persist indefinitely. (Not to be confused with the non-bulbous bluebells which belong to *Campanula.*) Cover 4 inches.

Scilla campanulata (*Endymion hispannicus*). Spanish Bluebell. Ten to 20 bells on a stem 12 to 15 inches high, giving the effect of a rather loose spire of Dutch hyacinth. Soft violet-blue is the basic color; there are varieties from deep to pale violet-blue, in white, and lilac-pink.

Scilla nutans (*Endymion nonscriptus*). English Bluebell. A slender, slightly smaller version of the Spanish bluebell. Less robust and showy, but nevertheless persistent.

Summer

Lilies: Two of our native lilies grow well in light-to-medium shade in rich, well-drained soil that does not dry out. Cover 3 inches.

Lilium canadense. Canada Lily. To 6 feet. Leafy stalks bear up to 20 down-facing recurved flowers, pale yellow to light orange, in midsummer.

Lilium superbum. Turkscap Lily. Flowers resemble the Canada lily, but are orange to red, and the petals are more reflexed, giving a more open flower. Midsummer.

Lycoris squamigera: Hardy-amaryllis. The foliage, resembling that of daffodils, appears in early spring, and disappears at the end of June. Up to seven lavender-pink, fragrant, lily-like flowers appear in early August at the top of a 2- to 3-foot stem. Long-lasting and prolific in good soil. Thrives in semi-shade. Cover 4 inches.

Grape-hyacinths *(Muscari)* are among the small spring-blooming bulbs suitable for shade. Above is the white form (known as "pearls of Spain") of *M. botryoides.*

Autumn

Colchicum: Like large crocuses up to 9 inches high. The large, broad leaves appear in early spring, and become a nuisance before they mature and dry up in late June. The large corms are poisonous, and left alone by rodents. Flowers, in variations of rosy purple, often lightly checkered, or white, appear in profusion in autumn. They can be planted in ground covers of ivy, pachysandra or vinca, or any light-to-medium shade where the ripening leaves will not be a problem. *Colchicum autumnale* and its white form are most often offered. Handsomer are *C. speciosum* and its very beautiful white form, and its variety *bornmuelleri,* earlier, and with a large white center; also a number of named varieties. Planting time is August or September. Cover 4 inches.

Crocus: Fall crocuses are dainty little things like the spring species. Protection from the north is desirable. There are no yellows. They range from pinkish purples to lavender-blues and whites. Cover 2 to 3 inches.

Crocus speciosus. 4 inches. A fine lavender-blue. There are good varieties, including a fine white. Prolific if the rodents spare it.

Other good ones include *C. kotschyanus* (*zonatus*), pale rosy lilac, *C. medius,* medium purple, *C. longiflorus,* paler purple; *C. laevigatus,* early winter.

Cyclamen: Not easy to suit. They need shelter from cold winds, good soil that does not dry out, shade in summer, and sun in winter, when the foliage is very attractive. Just cover the tubers lightly with soil, and add an inch of leafmold as a mulch. *Cyclamen neapolitanum* is the best to try first. The flowers are rosy miniatures of the florist's cyclamen about 3 inches high. The leaves are marbled with silver. Plant the smooth, rounded side of this species down. Be sure to get plump tubers as early in fall as possible, or get freshly dug plants in summer from the Pacific Northwest by airmail.

A last warning on all these plants. Remember that their foliage must not be removed until it has turned yellow and rather dry. ♦

Jeannette Grossman

California's fawn-lily *(Erythronium californicum)* in shade of spring garden.

White crocus in shade of Japanese privet *(Ligustrum japonicum),* also in shade.

For unusual effects and patterns in shade from both flowers and foliage

TENDER BULBS FOR SUMMER COLOR

John Philip Baumgardt

Molly Adams

Tuberous begonias in lath house. Also shown is a hanging basket of fuchsia, a summer-flowering tender perennial, another fine subject for shaded terraces.

TO PARAPHRASE Lewis Carroll's Red Queen, when I say "tender bulb," I mean any bulb, corm, tuber or tuberous root that is not reliably hardy in my Zone 5 garden. Flowers of plants that grow from a sort of underground storage organ often have a luminescence and carrying power lacking in other plants. For the shady garden these glowing flowers and the bold foliage of others take on special meaning. They light up the gloom; their boldness overrides the diffidence of the more delicate ferns, astilbes and other reliable shady garden plants. They become an added texture.

Lazy gardeners often avoid tender bulbs. I find the idea of planting one and bringing in five (with no income tax) appealing. But you do not have to bring these indoors in the fall. Plant them, enjoy their beauty for a season, and let winter take them. You can buy more next spring. While this is not my way of gardening, I condone it when it encourages someone to plant a group of ornamental plants he has been avoiding. When he falls in love with his calla-lily, he will take steps to save it.

The Quality of Shade: Shade is another of those indefinite garden terms. The shade under a high, arching elm tree differs considerably from the shade under a low, spreading maple or horse-chestnut. Under the elm, shade is protection from direct sunlight, but with full daylight. Under the low, dense tree it is shady *and dark*; light is greatly reduced. Native lady's slippers, wild-ginger, trailing-arbutus and the hellebores grow and bloom in very low light. But the tender bulbous plants want only protection from the sun's rays; they want full daylight, and most thrive on a little early morning and late afternoon sunlight.

Soils: Bulbous plants do not tolerate root competition; they will grow under deep-rooted trees, on the shady sides of buildings and in the lee of the garden wall only so long as the ground is unencumbered by roots of other species. This is easy because, as these are reset each spring, you may spade deeply to remove encroaching roots. Excellent drainage is a requirement of most of this group of plants, though elephant's ear and calla-lily will grow in water or at a pond margin. The others want a very porous, quick-draining soil that is typically "woodsy," that is, with a high humus content, circumneutral tending toward the acid side, and loose. They all need weekly water if rain fall is insufficient to keep the soil damp under the surface layer. Feed them as growth begins and until flowering is over; then let them slow down, preparing for a dormant period.

Exposure: Tender bulbs are damaged by wind; caladium foliage becomes frayed and tattered, begonia blossoms drop, stems of achimines become kinked. Plant them where the prevailing summer wind cannot damage them; as most are relatively low, sometimes it is possible to plant a temporary windbreak for their protection. In my cutting bed a row of castor bean plants provides shade and wind shelter for the ornithogalums and shade-loving annuals.

Kinds to Grow

Achimenes: These Central American gesneriads tolerate no chill. Start the tubers indoors, barely covered, in a flat of 2 parts each peat moss and loam, one part each leafmold and sand. Water moderately at first, freely when growth is active. Transplant into light shade or even where they receive only noon-time shade. Perfect for edging and low massing (set them 9 inches apart), these foot-high plants bloom freely from early summer until frost. Give liquid manure or fish emulsion solution monthly until August. Lift in autumn. Store in clumps of dry soil in a paper bag. Propagate by breaking old tubers in two or three pieces. Easy from seed, achimenes bloom the second year. The only serious pest is the slug.

Begonia: Tuberous begonias, widely grown for their magnificent, continuously produced blossoms, have been developed from six Peruvian and Bolivian species.

(*Continued*)

Press corms into a shallow flat of damp peat moss or fine leafmold (some specialists start them upside down) and barely cover, two months before outdoor planting time. When well rooted, move to 4-inch pots filled with a mixture of 2 parts each leafmold and soil and one part each dried cow manure and fine sand. Keep moderately damp and give liquid fertilizer (fish emulsion is my preference) and grow in bright light, no direct sun, until outdoor planting time. Transplant to the garden; taller cultivars need immediate staking. They want bright light, even a little early or late sun; they do not tolerate deep shade or darkness. Water to keep the soil barely moist; feed frequently until late summer. If basal rot or mildew becomes a problem, grow drier and water only by surface irrigation. Spray with Actidione PM or Karathane. Protect from slugs and snails as these pests can devastate a planting very quickly. Withhold water a month before frost and when leaves yellow lift with soil, keep dry, and after the tubers have ripened, store in paper bags, or clean the corms and store in peat moss in the basement. Propagate by halving large corms two or three days prior to rooting; sow seed (under fluorescent lights or in a greenhouse, at 68° F.) six months before planting-out time.

A wide range of cultivars is now available; for garden bedding the cluster-blooming kinds make the best showing. Purchase only plump, unscarred tubers; avoid shrivelled or injured ones.

Caladiums: Deserving wider garden use, these South American arums are valuable for their showy leaves. Buy plants started in a greenhouse or dormant tuberous roots. Start dormant tubers the same way as tuberous begonias, or pot up directly in 4-inch pots in a mixture of equal parts garden loam, coarse peat moss (damp), leafmold, composted manure and fine sand. I prefer to invert the tuber, covering to a depth of 2 inches, as more sprouts—and more leaves—result. Keep barely damp until growth is active, then water freely, and give mild liquid fertilizer twice each month through late summer. Move these to the border when the weather is quite warm. Caladium beds must always be moist. A shady garden planted entirely with *C.* 'Candidum' (white foliage with green veins) is cool and inviting; the colored-leaf forms bring life and excitement to even a somber garden. In early fall lift with a clump of soil, compress gently, and lay to dry in a shady, frost-free place; cut off dried foliage and store in a moderately warm basement. Propagate by dividing tuberous roots several days prior to replanting. Watch for slugs.

Colocasia: The familiar elephant's ear is *Colocasia antiquorum* from the East Indies; occasionally specialists offer *C. esculenta,* taro root, which is often available locally in Spanish American vegetable markets. Handle the tubers like caladiums, or plant directly in the garden when the soil has warmed up. Allow plenty of room, give full light, even a little direct sun, and keep very moist once growth has begun. For largest leaves feed weekly with dilute liquid fertilizer—I prefer liquid manure or fish emulsion solution. Cut to the ground when frost injures the foliage and allow the roots to cure in the soil for two or three weeks; lift with a ball of soil, dry and store in sawdust, vermiculite or in a paper bag in the basement. Propagate by severing offset tubers in the spring. From Zone 6 southward, plant these by moving water and cover deeply with garden debris over winter; they will survive without lifting.

Ornithogalum: We know these bulbs as European and African relatives of the invasive little star-of-Bethlehem that grew in grandma's garden. Plant bulbs of *O. arabicum, O. lacteum, O. nutans* and its variety *boucheanum,* and *O. narbonense* and its variety *pyramidale* when the ground is workable in early spring; they want only dappled shade and soil deeply prepared with well composted barnyard manure, or garden compost enriched and restacked briefly with a generous amount of 5-10-5 fertilizer and bonemeal. The

George Taloumis

Caladiums among pachysandra make an unusual border for a shaded terrace.

widest part of the bulb should be 3-4 inches below the surface. They need good drainage; water weekly when leaves appear and feed with very dilute liquid fertilizer twice monthly. Space bulbs 9 inches to a foot apart to make a display bed, or space more widely and interplant with violas or the new, very low impatiens varieties. Most of these ornithogalums send up 18-inch to 2-foot stalks, and the blooms hold very well so long as they are protected from wind. After light frost lift, clean the bulbs, cut back the tops, and store in vermiculite or perlite in a cool basement. In spring pull off and plant separately offset bulbs.

Zantedeschia: Calla-lilies (arums, in England) are easy; they grow in sun or shade (not dark), damp soils or standing in 6 inches of water. Their "bulb" is a tuberous rootstock; for bog gardens, plant the dormant root, covering to a depth of 2 inches, in mid-spring; for shady gardens start indoors six weeks before frost-free date; set one per pot, using equal parts of garden loam, old cow manure (compost is a poor substitute) and coarse sand. Water once, then no more until the shoot appears. Keep moderately moist; set out when the garden is warm, and, when established, push with weekly feedings of liquid fertilizer. A clump of half a dozen white calla-lilies, *Z. aethiopica,* is magnificent; for contrast, set nearby a broader planting of the lower-growing *Z. elliottiana* with white-spotted leaves and butter-yellow trumpets. The new *Z. rehmannii* hybrids come in shades of pink and bronze; they are handsome little fellows, seldom attaining 18 inches. The white-flowering cultivar 'Crowborough' is hardy through Zone 5. Lift calla-lilies in a clump of soil, air dry, and store overwinter in a cool, frost-free place.

Zephyranthes: Tiny zephyr-lilies make clumps and patches at the margin of my woodland garden. And every time it rains, or when I water, a new flush of blossoms appears. I plant the bulbs, covering with about 3 inches of soil, spaced every 4-5 inches, in mid-spring (they tolerate light frost) at the edge of shady patches. And that's all. With frequent watering, they are almost always in blossom; if the soil is fairly dry, bloom is sparse. As they are planted in rich soil, no additional fertilizing is required. In late fall lift the bulbs and let them dry—the foliage is very slow to shrivel, so after a couple of weeks cut it back to the top of the bulb. Store dry in a paper bag in a cool, frost-free place. Pull apart offset bulbs and plant separately. My main crop is *Z. grandiflora,* with a 3-inch, brilliantly pink trumpet on a 9-inch stem; but I grow several others including *Z. atamasco,* the atamasco-lily of Virginia, and *Z. citrina,* a small clear yellow species. ◆

Summer color from foliage and flowers

ANNUALS IN THE SHADE

Robert P. Wintz

PROVIDING COLOR in shady gardens poses a serious problem to many gardeners. What to do to add "a patch of blue" to an otherwise dreary location? To many, especially beginning gardeners, the answer may lie in the use of annuals—short-lived plants with extreme versatility, variable characteristics and wide color range.

The term annual plants is often used simultaneously or interchangeably with the term bedding plants, both referring to plants used for a single season's growth. Annuals started in the commercial greenhouse and sold to the consumer in early spring as young started plants are commonly referred to as bedding plants, as opposed to plants started directly from seed in the garden. Shade-loving annuals are usually difficult to start by direct seeding in the garden. Therefore, they are either grown on by the amateur gardener in a greenhouse, window or coldframe or purchased as bedding plants from the commercial grower at the proper planting time outdoors.

How to define shade? There is shade from buildings, shade from trees and shade from other plantings. Some shade is referred to as dense, some as heavy, and some as light. There is morning sun, afternoon sun, no sun. There is full shade, half shade, no shade. This term becomes quite relative, mainly to the individual and his own particular circumstances. You may have similar situations of shade, but one location may benefit from reflected light, another may be exposed to harsh winds, another may suffer from air pocketing and poor circulation. You must study your situation and be prepared to do some experimenting on your own.

In reviewing statistical data as to amount of seed and plants sold, there are three annuals for shade that stand out above all others. They are "the big three"—begonias, impatiens, coleus. The impatiens (*Impatiens sultanii*), or more commonly called patience plant, is one of the most dependable of all flowering annuals for shade. Much breeding work has been done over the past few years with impatiens, so that today you have a plant that is quite different from its ancestors. The old impatiens grew rather tall and leggy, with spare bloom. Today's model is dwarf in habit and free blooming. Notable among the new varieties are inbred selections with bright satiny blooms on dwarf 10-to 12-inch plants. Examples are Blaze, a bright orange-scarlet with contrasting dark foliage; Dwarf Bright Orange, with sparkling orange flowers; and A-Go-Go, a unique, colorful, red and white bi-color, the first variegated impatiens. Newly introduced are the F_1 hybrid Elfin impatiens—the most dwarf and free-blooming strain yet developed. A mass planting of these impatiens hybrids is quite a sight to behold, even in a fairly heavily shaded location.

Equally dependable for bloom and habit are the bedding or wax begonias (*Begonia semperflorens*), with foliage in many cases as colorful as the bloom. Subject to much hybridization in recent years, begonias have been bred to be sun tolerant, as well as shade tolerant. They are totally reliable, all-round good annual plants. Choose from dwarf and semidwarf forms with flowers in shades of pink, rose, red and white, and either green or bronze foliage. Favorite varieties include Pink Pearl, a dwarf pink with green leaves; White Tausendschon, a dwarf pure white with green leaves; Red Tausendschon, a semidwarf, clear red with green foliage; and Red Comet, a dwarf red with bronze foliage.

Rounding out "the big three" for shade is coleus (*Coleus blumei*). Through careful selection, varieties have been developed that are true to type and color from seed. Thus you can have plants for mass planting or combination planting that are dependably uniform. Selections are available in vibrant shades of rose, red, and scarlet, as well as the popular green and ivory (Candidum) and other bi-and tri-color combinations of all these shades. Of "the big three," coleus is perhaps the most reliable for very dense shade.

Other annual plants that do well in medium to light shade include:

- Anchusa
- Balsam
- Browallia
- Calendula
- Centaurea
- English Daisy
- Euphorbia
- Lobelia
- Lunaria
- Lupine
- Myosotis
- Schizanthus
- Sweet-alyssum
- Thunbergia
- Torenia
- Vinca

Normally an edging plant, sweet-

Pan American Seed Co.

Top, above: Petunias in containers may be shifted from sun to shade for a few days. *Above:* Plants of wax begonia and lobelia make a colorful white-and-blue combination in a partially shaded corner.

alyssum will survive in a shady location, but the amount of bloom will reduce as the degree of shade increases. Therefore, don't expect the bloom to be uniform when used in a border that runs from sun to shade. For uniform bloom in a border, it would be better to use a wax begonia.

Garden balsam (*Impatiens balsamina*) is a close cousin to the patience plant, both being in the same genus. New forms are more dwarf in habit, with considerably more bloom. Browallia and torenia are two less-known annuals that should be more widely grown. Both have delicate and unusual flower forms and colors, and are suitable in beds or hanging baskets.

For that "patch of blue," it is hard to beat the ice blue shade of lobelia. Grown as a border, or in mass, the effect is always striking.

Vinca rosea, a tender relative of perennial ground cover *Vinca minor,* is useful with or without blooms. The foliage is rather heavy textured with an attractive sheen. The denser the shade, the fewer the blooms, but that may well not matter.

The plants that have been mentioned were selected because they are almost foolproof for a shady location. As has been discussed, there are all degrees of shade, and there are numerous other plants to try. I say try, because today with the many developments in hybridization, there are more and more plants to grow under conditions their predecessors could not manage.

Other annuals normally classified as "sun lovers," such as snapdragons, verbena, nicotiana, cleome, Drummond phlox, as well as some marigolds, are being grown with varying degrees of success

With advances in plant breeding also come advances in growing techniques. Growing plants in containers is an example. Today's spacious patios, and indoor-outdoor rooms are especially suited to plants in containers. And not to be outdone, the modern city dweller brings the country to the city—possibly because of increased use of expanses of glass and tubbed plant material. Enterprising plantsmen are quick to call for materials to meet the need—containers that are

Pan American Seed Co.

Rainbow coleus and wax begonias can make effective partners in partial shade.

durable and light, soil media that are rich and water retentive, plants that will flourish in confined areas. The fiberglas-and plastic-container boom is on. Today, you can buy 3-foot-diameter tubs or urns that for all the world look like concrete, yet are so light you can balance them in the palm of your hand. Furthermore, they are actually more durable than concrete. Other types are available in all shapes, sizes, and materials.

How does all this apply to shade gardening? It simply means that almost nothing is impossible. When grown in containers, sun lovers if moved into shade will be shade tolerant for a time. Not permanently, of course, but temporarily for the special occasion—the garden club meeting, when weekend guests drop in, for the garden party—just move them from one spot to another.

Can vegetables be grown in shade? So often, I've heard people complain that they can't grow vegetables due to a lack of sufficient sunshine. Generally speaking, this is true. Vegetables do need ample sun to produce a satisfactory crop. But again, this can be a matter of degree. By thoroughly knowing your garden situation, I feel certain there are ways you can achieve some measure of success.

Lettuce, radishes, salad onions, mustard, chard, turnips and beets are all cool-season crops that if planted early enough may develop into usable crops before the dense leaf growth of trees and shrubs in late spring. Your measure of success will depend on all other growth factors being optimum—a rich, humusy planting bed, good drainage, weed-free conditions.

Put vine crops, tomatoes, and corn out of your mind—they need plenty of sun. I have had snap beans, on the other hand, produce quite well in partial shade, because I selected a heavy-yielding variety.

Growing in movable containers can also be a solution. You can grow a fine crop of kitchen herbs in a movable tub, or other container. And you can have the tomatoes you want by growing the new varieties, such as Patio, which will produce a heavy yield in a 10- or 12-inch pot. They, naturally, must be placed in a sunny location a good part of the day. ◆

Pan American Seed Co.

Thunbergia hanging basket for shade.

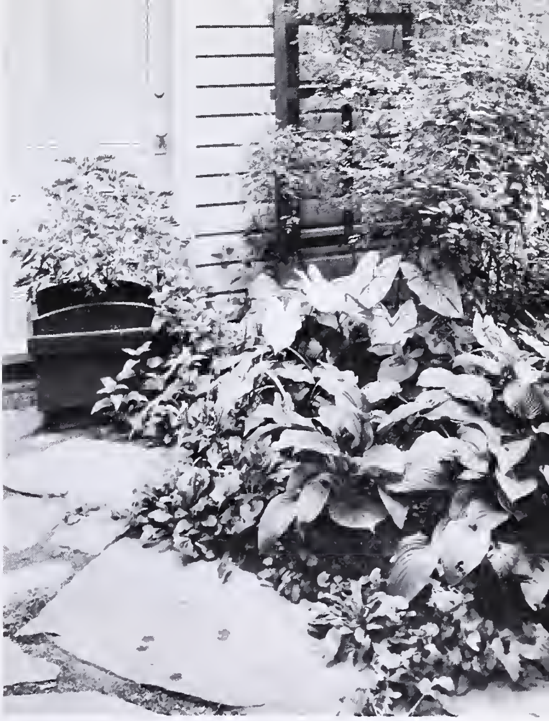
Peto Seed Co.

Tomatoes in pots—move them with sun.

A planted corner of a terrace which receives only filtered sunshine contains the shrub winter-hazel *(Corylopsis)* and such herbs as basil, parsley, rosemary, pineapple-sage, thyme, burnet. The creeping ground cover in the foreground is perennial pennyroyal *(Mentha pulegium)*, which is grown from seed sown each spring.

There is a wide choice for

FOLIAGE EFFECTS IN SHADE

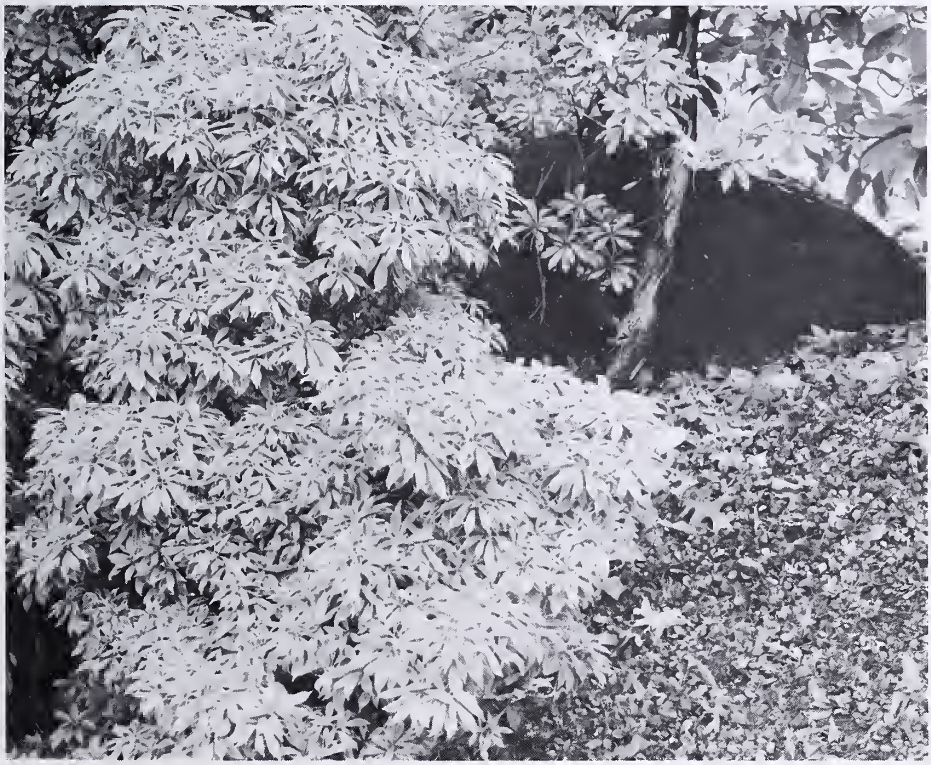


Right: Coleus (by door), caladium, hosta and ajuga contribute pattern and textural variety in shaded doorway garden.

Gottscho-Schleisner

Below: Of year-long interest in Harold Epstein's garden is this combination of a Japanese andromeda (*Pieris japonica* 'Variegata') with white-margined leaves and ground-covering *Phlox stolonifera.*

Marjorie Dietz



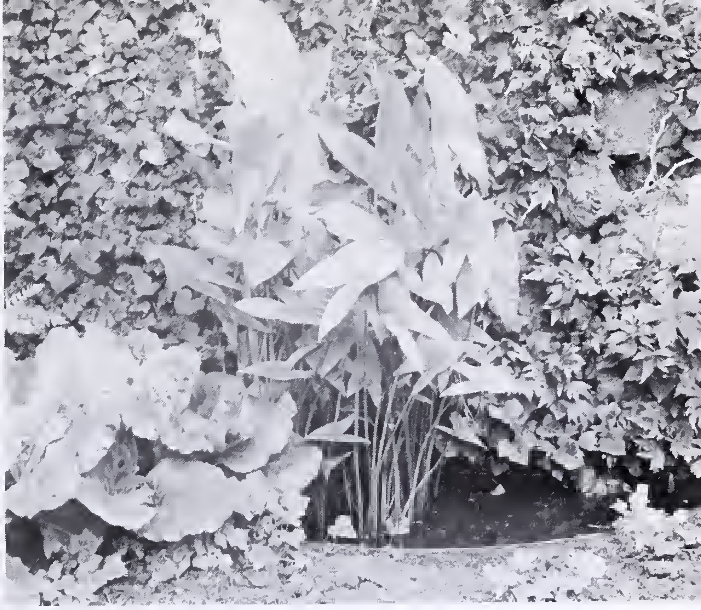
Jeannette Grossman

Northwest natives vine maple (*Acer circinatum*) and *Mahonia nervosa* in shade.

Jeannette Grossman

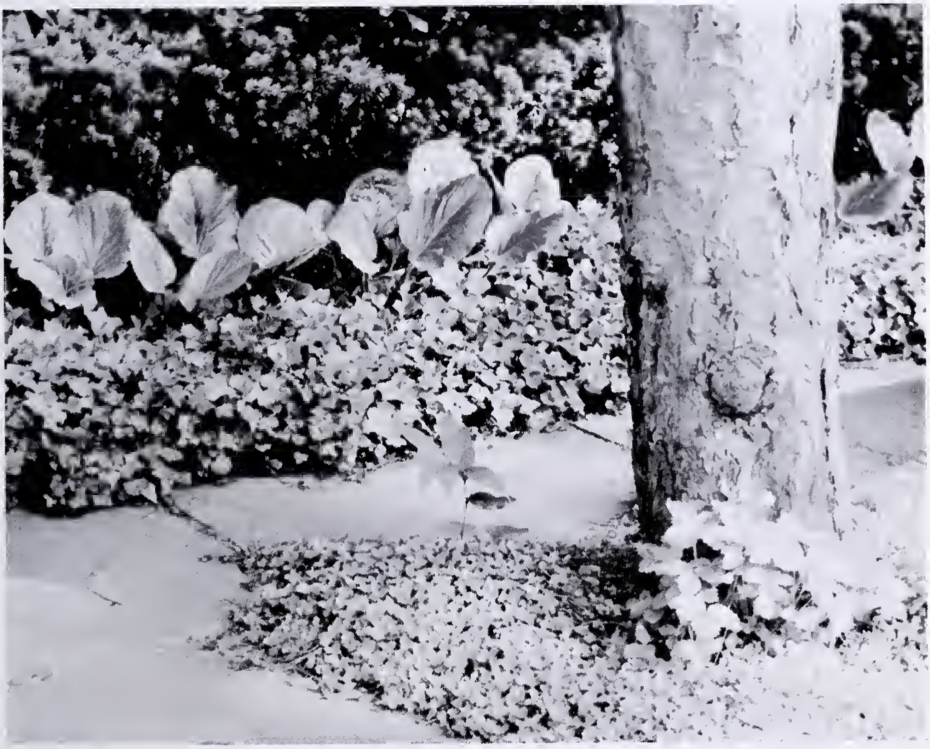
Pacific Northwest planting for terrace is of fatsia, ivy and *Iris foetidissima*.

This shade garden is composed primarily of foliage plants—myrtle, hosta, English ivy and ajuga—but there are touches of color in spring from ajuga and myrtle.



Right: But few aquatic plants thrive in shade; an exception is arrowhead.

Molly Adams



George Taloumis

Corner of shady terrace is planted with such shade lovers as yew, bergenia, English ivy, and around the trunk of the apple tree, *Sedum spurium* and wild strawberry.

HOSTA AND THE SHADY GARDEN

This perennial standby for shade is undergoing a renaissance in modern gardens

Alex J. Summers

Gottscho-Schleisner

The perennial hosta, available in a variety of foliage patterns and forms, contributes sculptured beauty to the shaded garden, as shown in the spring scene above.

BOTANISTS AND OTHERS have had a great game with the genus *Hosta,* changing names without regard for those already in use, or using the same name for a number of plants. Hosta, which is often called plantain-lily, is still occasionally sold as *Funkia,* a generic name which was changed in 1905! Even the great Liberty Hyde Bailey contributed to the hosta muddle by calling *H. cathayana* first *lancifolia fortis,* and then soon after, applying the same name to *H. undulata erromena.*

Most people are familiar with hosta in its commoner forms, such as *H. undulata,* with the leaf broadly striped white in the center; *H. cathayana,* the early-sprouting species known under a variety of incorrect names, which flowers in September; and the old-fashioned August-lily, *H. plantaginea.*

Because of the identity confusion among hosta plants, many commercial growers offer mislabelled plants and many individual plants can be bought under a variety of names. It is not unusual to find that some brand new name and a fancy price have been applied to plants which have already been in existence for some time. The future hosta buyer should beware and when possible, see the plants before buying.

As most hosta species are natives of Japan (and a few of China and Korea), it is to be expected that the only comprehensive work on nomenclature problems regarding the hosta muddle has been done by Japanese botanists, with Fumio Maekawa's monograph of 1940 the best known. There are close to a hundred species, forms and varieties described by the Japanese. Some of the so-called species are hybrids, and many so-called varieties are garden forms and nowhere to be found in the wild. Hosta in the wilderness is a variable plant with no clear line of demarcation between one species and the next, with everything between a classification problem. To add to the confusion of the older hosta population in this country, many new plants have been imported recently from Japan, some of which are valid species collected in the wild, some divisions of selected Japanese garden seedling-grown plants. And, of course, the most baffling are the plants either received as hybrid seedlings, or grown from seed collected in Japanese gardens and producing hybrid offspring. Add to all this the many seedlings grown in this country from garden material, which often self-sows, and it is not unusual to find hosta enthusiasts with well over a hundred cultivars, most of which have names only more or less accurate, and again, subject to change!

Hosta in the Garden

Hosta can be divided generally into two groups; the first, those which bear seed which should be prevented from forming by removing the fading flowers to avoid self-sown seedlings, or, if a few are permitted to ripen, gathered as soon as ripe, and grown elsewhere. They may be sown in fall or spring outside, or grown under lights in the basement or in a greenhouse. Seedlings started under glass will occasionally flower the first year, but usually it takes two years for small-leaf types and longer for larger-leaf types. Self-sown seedlings should never be permitted to take over the garden as the result will soon be a jungle. The second group of hosta are those more or less sterile plants which, even though known as species, are undoubtedly of garden hybrid origin, as without seed for reproduction they could not endure in the wild. This seedless group naturally is less of a problem for the gardener who turns to hosta for permanent garden or landscape effects. For those gardeners interested in handsome foliage effects, and not particularly in the flowers as such, most of the seed-bearing hosta can be happily grown in heavy shade, where they will not flower at all (thus setting no seed) and, especially in the variegated leaf forms, light up such dark and often neglected areas with gleams of silver or gold.

Hosta may again be divided into size groups and indeed must be so that proper placement is insured. Certainly the wee ones must be kept from hiding behind the giant ones. All the tiny hosta are new to this country with the early flowering *H. nakaiana* probably the most common. It was introduced as 'Nakaimo Minor.' ('Nakaimo' is a larger-leaved plant, apparently a hybrid with *H. capitata* influence.) Another early flowering tiny hosta, smaller than *H. nakaiana,* is *H. venusta.* Both of these will rebloom and this year *H. venusta* was seldom without a flower spike—if a 10-inch spike can be called that. As both these species set seed profusely, many hybrids are being grown, often with quite large leaves, indicating cross-pollination with large-leaf types. Other small-leaf, later-flowering species are *H. gracillima* and a wee plant from Saishu Island called 'Yaku Giboshi.' This last forms a flat wheel-like arrangement of elongated narrow leaves often veined with yellow and flowering in September. *H. gracillima* also flowers at this time. It has slightly larger leaves held from the ground, although also spreading. The old *H. lancifolia albomarginata* has produced some seedlings more variegated than itself and, in one case, a mutation or sport also more centrally variegated. These variegated gems, due to lessened amounts of chlorophyll, are appreciably smaller than the parents and should be fascinating for the shady rock garden. One seedling of *albo-marginata* has appeared with a nice gold edge, a distinct contrast with its white-edged parent. Small variegated-leaved plants will soon be plentiful, as many retain variegation from seed, particularly seedlings from 'Beatrice.'

The medium-leaf-sized hosta have been used for edging for generations, but the two most commonly used are far from ideal for the purpose. *H. cathayana,* the old *lancifolia, lancifolia fortis, or japonica,* among other names, seems more prone to insect attack than others, and it also has the unfortunate quality for us of turning yellow and then brown after we water the lawn on a hot day with

Jeannette Grossman

Shade and rich moist soil favor *Hosta sieboldiana* (rear) and *H. undulata.*

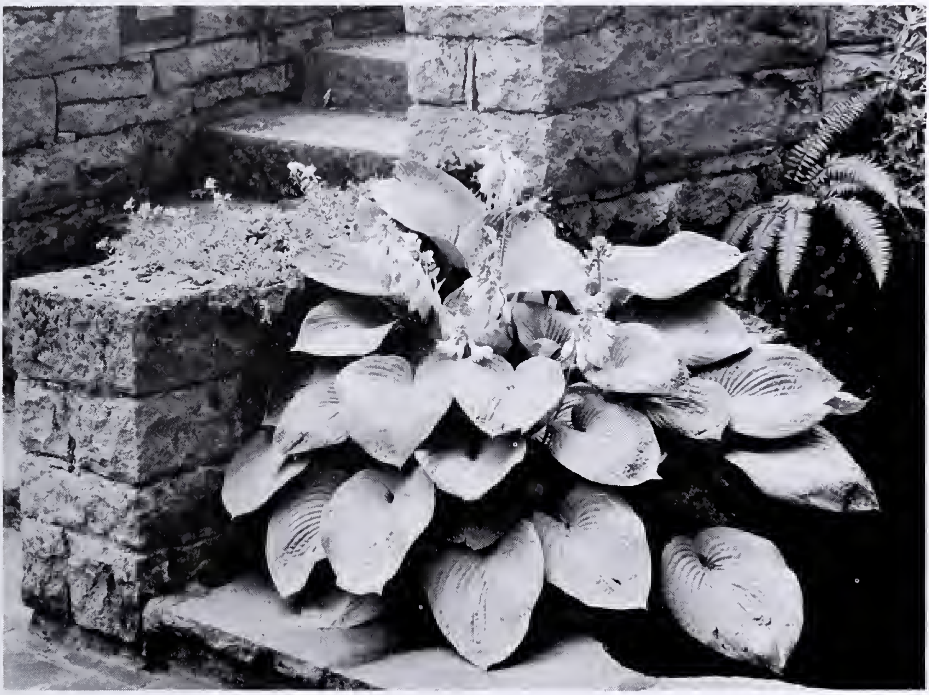
our cold well water. Another suffering in this manner is the old *albo-minor*. Breeding has produced darker, thicker foliage and larger white bell-like flowers from *albo-minor,* but they have not been tested for cold water resistance. Just as common for edging is the variegated-center leaf *H. undulata.* This has the undesirable habit of producing plain green leaves during the summer, hardly an asset. Many new hosta show interesting possibilities for border or path edgings.

There are dozens of large and giant-leaved plants (some up to 12 by 18 inches), suitable for ground cover when planted in groups, or alone as an accent. These large plants, to be effective, must have good culture and plenty of water. The giant variegated leaf-types are then garden traffic stoppers.

Aside from small- and large-leaf hosta types, both of which have plenty of variegated forms, there are some that are appealing for their solid blue or glaucous leaf color. One species, *H. tokudama,* is extremely blue with a round, cupped, seersucker leaf, and there are forms of other species, such as *H. sieboldiana* and H. *nigrescens,* with very blue leaves. Other species have forms with lessened amounts of grey or blue grapelike bloom on the leaves, some with more on the reverse leaf side. One with a grey-white reverse is the white-backed *H. hypoleuca* 'Urajiro.'

Fragrance is always a desirable quality, and the old-fashioned August-lily, *H. plantaginea,* is well known for it. The larger-flowered 'Grandiflora' form with flowers up to 9 inches is very elusive and the double-flowered form even more difficult to find. Fragrant hybrids are few; 'Royal Standard' in pure white, 'Honeybells,' off white, and 'Sweet Susan' in lavender are about all that can be easily obtained.

Shade is essential in the summer gar-



Jeannette Grossman

A dramatic accent is this one *Hosta plantaginea,* sometimes called August-lily.

J. E. Downward

Hostas are often suitable for grouping in the foreground of shaded shrub borders.

den for relaxation and tranquility when temperatures become too hot for garden activity. Indoor air conditioning may offer relief for some people, but the outside can also be air-conditioned. Circulation can be improved for both the comfort of people and plants, and can serve to keep out mosquitoes and lessen the slug problem. Too many gardens are closed in by dreary masses of grouped shrubs which can be functional as screens, but after a few years, become airless traps from which one wishes to escape.

So, shade should be high with openings to allow the entrance of air and light. This is the kind of shade that the perennial hosta appreciates, although hosta will adapt itself to all degrees of shade, providing soil moisture is adequate.

Perhaps the best shade is that derived from tall pines, although personally I like Japanese yew and American holly, trimmed high, for the berried effects and bird activity they create. Ideally, oak, tulip and apple trees should be avoided because of the inch-worm problem, and falling fruits from apples are an additional hazard to hosta foliage. Tulip and maple trees attract aphids and the subsequent honeydew dropped then turns to sooty mold, which disfigures all vegetation beneath.

So much for the canopy for hosta plants. Other plants I like interplanted with hosta are the fall-flowering evergreen liriopes, particularly 'Monroe's White' and the variegated-leaved 'John Burch', which has extremely dark flower stalks as well as dark flowers. Also, not to be overlooked are ferns, which blend beautifully with hosta, and may be used with them in the most delightful combinations. The Japanese painted fern is used here in quantity and is a very early indicator of drought, as it flattens out as the ground dries and becomes erect again on watering. Two precautions: do not plant hosta in beds of ivy or pachysandra; do not use too much rough litter which may attract mice (especially the short-tailed pine mice), who find hosta roots extremely palatable.

Sources for hosta mentioned above are not plentiful. Perhaps the best plan would be to join the American Hosta Society. Dues of $3.00 can be sent to Mrs. Glen Fisher, 4392 W. 20th St. Rd., Oshkosh, Wis. 54901. ◆

CHOICE PRIMULAS FOR MONTHS OF COLOR

The earliest primroses begin to flower in the snow

Alice Hills Baylor

THERE ARE MANY LOCATIONS in the shady garden where the colorful and charming members of the genus *Primula* may be planted—beside a pool or brook, along a path shaded by rhododendrons or other shrubs, under an apple tree or an evergreen, in light woodland or in partially shaded sections of the rock garden. One small planting will be the forerunner of others, for it is quite impossible to be satisfied with a few once one has successfully grown these treasures. There are hundreds of primulas and fortunately many can be grown by meeting only a few of their requirements. Others are difficult to bring into bloom as it is nearly impossible to imitate the growing conditions of their native habitat. (Perhaps this last reason is why many of us try again and again to germinate seed of these difficult species.)

The range of primrose colors is so great that any combination or blending of the many kinds can be made. Intense shades and vivid colors contrast with pastels; the cool shades seem to accentuate the brightness of their neighbors while yellow and white primroses serve to knit the garden's pattern into a harmony of tints and tones. Many members of this magnificent plant group ask only for partial summer shade, soil that has been deeply cultivated and enriched with humus and organic fertilizer, moisture during the growing and flowering season, excellent drainage, and a mulch to conserve moisture and create a cool root run.

The first requisite is partial shade. Or one might use the term "dappled shade" which suggests that primulas should have sun on their flower heads for a short period each day. They should be planted where air circulates freely as they do not like to be smothered.

When preparing the planting site, dig deeply to avoid later effort. Such thorough preparation may save the primroses during a dry period. Here at Sky Hook in Vermont, we dig two spades deep, saving the top soil in a wheelbarrow from the first excavation to use as the top for the last portion. The subsoil is turned and a 2-to 4-inch layer of humus (leafmold, compost or old hay) is added. The top soil from the next space is put on top of this prepared area and thus we continue. This method of preparation ensures moisture retention, adequate space for roots to run for food and an area 2 to 3 inches above the surrounding ground to give perfect drainage. The mulch, which is put on after planting, adds another 2 inches to the height of the bed. The edges of the beds in our primrose garden are low stone walls on which grow the dwarf species. In the woodland garden we use logs, which create a naturalistic scene to hold the prepared soil.

When setting out individual plants, start with a large hole as it is most important for the roots to have plenty of room when spread out. A trowel full of dry cow manure is placed at the bottom of the hole and the plant is held so that the crown is slightly above the surface of the bed and the roots not quite reaching the bottom of the hole. Soil is filled in around the roots about half way to the crown, then water is added to wash down the soil and to avoid air pockets. More soil is finally added to fill the hole. The crown of a primrose plant should not be covered with soil or mulch. If primroses are planted in this manner there is no need to remake the planting site for three or four years, unless one wishes to add to the supply by dividing the plants. When an entire area is planted it is soaked and the mulch added. If planting is done in fall an early spring mulch is advised; if in spring, mulch again in summer. This may be any good humus mixture—compost, leafmold, or ground corn cobs, peanut hulls or ground bark, to which fertilizer has been added. (*Editor's note:* The fertilizer, which is recommended for the purpose of replacing soil nitrogen, temporarily lost through action of bacteria in decomposing the organic matter, can be any nitrogenous fertilizer, such as nitrate of soda, applied at rate of 1½ lbs. per 100 sq. ft., or sulfate of ammonia, applied 1 lb. per 100 sq. ft.)

Perhaps more primroses have been lost in winter due to too much protective covering than not enough. They are hardy denizens of cold regions, high mountains, crevices and meadows where their long roots penetrate deep into the soil for food and moisture. The gardener can protect primroses from stinging winds with spruce or other evergreen branches (discarded Christmas trees are excellent), or any material that will not pack. Avoid leaves; rather use corn stalks or spent tomato vines as a winter scarf for primroses. This type of covering will hold snow in place; when snow is lacking, it is sufficient protection. The shelter of a large rock and the coziness of a log are also to their liking.

The joy of gardening begins early as spring approaches. The first flowers are so welcome; some primulas bloom as the snow that covered them melts. The brilliant *Primula rosea grandiflora* and its smaller forms, Petite Pink and Kleinii, are miniatures and often flaunt their 3-6-inch cluster against winter's white blanket. For that reason they should be planted where they will be seen and appreciated when it may be difficult to

Molly Adams

Walk down proverbial primrose path becomes a reality when one is blessed with a woodland in which to plant primroses.

Jeannette Grossman

Partly shaded spring border is lighted by bright yellow primroses and daffodils.

venture too far into the garden. When several plants of *P. rosea* are massed together the clusters merge completely, hiding the dark green pointed foliage. A humus-enriched pocket in the rock garden, with a northeast or northwest exposure, and filled with plants of *P. rosea* will make an unforgettable picture in early spring. One should transplant or divide this little beauty very soon after blooming, as it needs time to establish its wiry roots. I learned this to my great disappointment when I divided them in early September one year and in spring found that frost had heaved them out of the ground. They may be raised from seed, which should be fresh; or the plants can be divided as *P. rosea* multiplies faster than many other primroses.

As soon as the snow melts and the warm breath of spring is in the air, the fat buds of *Primula denticulata* push up sturdy stems and soon become round flower heads of lilac to lavender, or pink, rose, red, deep purple or pure white. This early bird comes to us from the Himalayas and is one of the easiest primroses to grow. It grows readily from seed, or the old plants may be divided. There is only one special requirement to provide—and that is drainage, for if water stands on or around the crown *P. denticulata* becomes the victim of crown rot. (When this happens the roots can be lifted, each planted separately, and a small new plant will develop.) The foliage of *P. denticulata* becomes large as the season progresses, so 6 to 8 square inches of space should be allowed. If the foliage wilts during hot summer weather, the outer leaves may be removed and the plant soaked after the sun has set.

Following on the heels of these earliest of primroses are the precious and colorful varieties and hybrids of *P. juliae*. The mass of bloom, the range of colors, both of the carpet and the stalked Julianas, repay bountifully with only a minimum of care. The species is a recent addition to the Vernal group as it was discovered in 1911 in the Eastern Terminus of the Caucasus in Asia Minor. Since then it has been hybridized with *Primula acaulis* and *P. polyanthus* to give us many hybrids. The species is a flat plant with extremely small, heart-shaped foliage and crimson flowers with a white eye. Its offspring will spread by creeping root stock and should be used as an edging, in a pocket of the shaded rock garden or beneath flowering trees or shrubs. The colors are rich crimson and burgundy, bright pink to shell pink, lavender, pale yellow to bright yellow, opal blending to pure white. The carpet types have a single flower on a stem, the stalked, a cluster of florets on a 3-4-inch-high stem. The roots have a tendency to come to the surface, so the fertile mulch is necessary.

Primula abschasica has been grown in this country in only recent years. The seed was sent from the Leningrad Botanical Society. Its natural station is in Abschasica in the Russian Caucasus. This species is a charming addition to the Vernal group for the wine-purple flowers bloom very early in spring and give a second flowering in fall. The rosette of leaves lies flat upon the earth and the many flowers, each on a single stem, almost completely cover the foliage. It has been crossed with *P. acaulis* by H. Lincoln Foster, who introduced it to this country with pleasing results, for the beautiful flowers are extra large, and have a larger eye, which is rose colored.

The vernal primroses are those from the moist meadows of the British Isles and Europe. They are of the easiest culture and give to spring a wealth of bloom. The beloved English primrose (*P. vulgaris*) bears each yellow flower on a single stem. It has been crossed with a native of eastern Asia, *P. sibthorpii*, which is pink, resulting in the plants we know as *P. acaulis*. They are colorful beauties, with flowers so abundant as to make a solid bouquet from a single plant. The other member of this group is *P. polyanthus*, which is perhaps the most popular garden primrose. It is the "bunch primrose," its cluster of flowers held on a 6-to 8-inch stem and in colors that defy description. This primrose is the result of hybridizing *P. veris* and *P. elatior* and other primroses from different parts of the world which had red, lavender and purple flowers. From these crosses, which have endured for many generations, have come primroses of "rainbow" hues. These glorious primroses bloom in May and are exceedingly spectacular.

Of the many others in the Vernal group, one or two should be mentioned. The primrose from Ireland, 'Garryarde Guinevere', will stop a garden visitor with the appeal of its outstanding form and deep bronze foliage. It is one of the most beautiful plants in its entirety because of the contrast of pink flowers above the curled red-bronze leaves. Also of interest is the Cowichan strain of primroses, whose plants also have bronze foliage, but eyeless flowers of deep red, and of satin-substance. There have been several good color forms of the Cowichan strain hybridized in recent years. All of the many Vernal primroses multiply and can be divided in a year or two with ease to make a greater supply for one's garden.

After *P. polyanthus* has claimed the scene for about a week, the various auricula primroses open their buds to expose their distinctive velvet-textured flowers. Wild forms from the European Alps have been hybridized for over a hundred years, to produce our lovely garden auriculas. All the auricula group can be distinguished by their smooth, almost succulent, leathery leaves which can be toothed or smooth. Others have dark green or grey leaves with a farina like coating, and a few have a white leaf margin. These mountain dwellers, which can be found growing in rocky crevices and screes, have adapted themselves to our gardens and are enduring and hardy. They ask for a top dressing of limestones or gravel over the humus-enriched soil. They also endure a sunnier location than that of other primulas. All auriculas produce side shoots which can be removed and rooted. From seed they will produce wondrous colors.

Towards the end of May while the Vernal group is still putting on a show, we at Sky Hook are drawn towards the woodland where the stately candelabra primroses are planted around three small pools connected by a tiny brook. These are the Asian primroses—from Japan and the high meadows of the Himalayas—and extend the primrose season into June. Here the soil is woodsy, black and rich. Here the candelabras spread their broad leaves and send up the flowering stalk on which tier after tier of florets appear. *Primula japonica* is the first to come into bloom. The near side of the pool garden is planted exclusively to them. The upper reaches of this area have the white-flowered varieties, which merge into pale pink, then deep pink, with the glowing reds along the brook connecting the upper pool with the second one. They seem to wade into the water that drips from the stair-step brook and their seeds germinate on moss-covered rocks. The Oriental hybrid candelabras (those of *P. bulleyana, P. beesiana,* and *P. burmanica*) bloom a week or so later than their Japanese counterparts. Among the flower colors are pure white (Mt. Fujiyama), bright yellow (Oriental Sunshine), tangerine and vivid blends (Oriental Sunset), brilliant red (Manchu Red) and shell pink (*P. pulverulenta,* Bartley Strain, with farina-covered stems). There are also pastel, coral, pink and fuchsia varieties. They are all of easy culture and if one does not have a woodland, they are spectacular against an evergreen planting or in a nook of shrubs or beside a pool. They enjoy more moisture than the primroses mentioned, but must not be planted where water is stagnant. They may be propagated both by seed and division.

In July the belled primroses take our interest when *P. alpicola* blooms. There are three forms of this fragrant primrose with its 12-14-inch stem bearing a spray of nodding bell-shaped flowers. Violacea is lavender to lilac, and there is a gray one I call "Old Smoky"; the white form is lovely, and the lemon-yellow one, "the moonlight primrose of Tibet," is heavily podered with farina. It is one of the main attractions in the garden on a summer evening. *P. secundiflora,* from China, bears from narrow, serrated leaves a 12-stem topped with nodding clusters of colorful bell-shaped florets of rose, deep wine, or purple. The root system is much shorter than the others in this group and the foliage rosette should be ringed with small stones to keep it securely in place. It is perfectly hardy. Both *P. sikkimensis,* found by Hooker in Sikkim, and *P. florindae,* found by Kingdom-Ward in Tibet, are very much alike. They are both yellow, bloom together in late July or August, and have beautiful foliage, which is a garden ornament in itself. They both also have a large "sunburst" cluster of many florets, often 30-60 in one spray, which are delightfully fragrant. Both cross so freely with other members of this group (especially with *P. alpicola* and *P. waltonii*) that it is difficult to keep the type and many colorful hybrids are produced. All of the plants in the Sikkimensis group need deep, moist, rich soil, about a half of which should be humus. Their native homes are the wind-swept heights of the Himalayas, along streams or under the spray of waterfalls. They have conformed to the conditions of our gardens to give us a remarkable tribe of late-blooming primulas.

When the fragrant bell primroses go to seed, there is often bloom on the early Vernal group to give a garden walk a little excitement. Then in November a pink or crimson flower will lift its head above a sifting of soft snow as though to remind us that another primrose season will give us joy when the snow melts in spring. It is then we place evergreen branches over the primroses to protect them from stinging wind. The branches will also catch and hold scarlet maple or dogwood leaves to make a patchwork winter blanket. ◆

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The American Primrose Society invites membership. Dues are $5.00 a year. Write Mrs. Lawrence G. Tait, Treasurer, 14015 84th Ave., N.E. Bothell, Washington 98011.

HARDY VINES FOR SHADE

Boston-ivy (*Parthenocissus tricuspidata*)—Evergreen vine for covering brick and masonry. Two forms, 'Lowii' and 'Beverly Brooks,' have small leaves and neat habit.

Bittersweet (*Celastrus scandens*)—Suitable for semishade. Degree of fruiting decreases as shade increases. This vine is too rampant for most suburban situations.

Clematis (*Clematis*)—Most kinds of clematis will flower adequately in partial (not dense) shade, so long as the soil remains rich and reasonably moist.

Climbing Hydrangea (*Hydrangea anomala petiolaris*)—Handsome flowering vine for various degrees of shade. Clings to tree trunks.

Dutchman's-pipe (*Aristolochia macrophylla*) — A fast-growing, leafy vine suitable for screening and to provide shade for porch, trellis, arbors. It is a twining rather than clinging vine.

English Ivy (*Hedera helix*)—Standard evergreen vine for dense shade. In the North, the foliage burns badly unless plants grow against walls with northern or western exposures and are protected from strong wind. There are many varieties.

Honeysuckle (*Lonicera japonica* 'Halliana')—A rampant vine with fragrant summer flowers. A last resort for vast areas in shade.

Silver-lace Vine (*Polygonum aubertii*)—Fast-growing twining vine with abundant showers of cream-colored flowers in late summer.

Virginia Creeper (*Parthenocissus quinquefolia*)—Familiar clinging vine of woodlands. It will climb stumps, rocks, tree trunks, walls, but is generally too rampant for small properties.

Wintercreeper (*Euonymus fortunei*)—An evergreen shrub or vine which clings to supports by suckerlike rootlets. There are several selections, some having variegated foliage. Most are fairly compact rather than rampant and suited to small properties. ◆

Genereux

Above: Akebia quinata is a twining vine for light rather than dense shade. Its foliage arrangement is distinctive.

Below: Climbing hydrangea *(Hydrangea anomala petiolaris)*, a majestic clinging vine for sun or partial shade.

George Taloumis

Jeannette Grossman

Western sword ferns, with the fleshy-leaved bergenia and delicate, white-flowered sweet woodruff (*Asperula odorata*) catch filtered sunshine by a rocky outcropping.

Most shade problems are easily solved by planting ferns . . .

SELECTED FERNS FOR THE SHADY GARDEN

F. Gordon Foster

TO THE BOTANIST or gardener the words "ferns" and "shade" are almost synonymous. Although ferns are sometimes found growing in areas of full, all-day sunlight, most prefer either filtered sunlight or alternate periods of full sun and shade. Some ferns seem indifferent to soil requirements, others thrive on limestone, but the majority grow best in moist, slightly acid, loose soil.

Ferns have three major components—the leaf, rhizome, and roots. Often growers classify ferns by the size and architecture of their leaves, and say little or nothing about the hidden rhizome-root-system. In most northeastern ferns the rhizome, really a modified stem, grows just beneath the surface of the ground and is never seen. In general, rhizomes fall into either one of two categories; that is, a runner or crown type. Ferns having rhizomes of the first group form good ground covers and are best planted where they will not invade other areas with their spreading habits. Crown-forming ferns continue to grow as individual plants and have little or no tendency to spread.

For garden use, ferns may be divided into three groups. First the "monarchs" consisting of the three osmundas and the ostrich fern; then the "intermediates"—shield ferns, lady ferns, hay-scented fern and others; and lastly the "miniatures"—ebony and maidenhair spleenworts, polypody, and fragile fern. These are just a beginning; as your garden progresses more may be added.

There are three species of the genus *Osmunda* in this area—interrupted fern, *Osmunda claytoniana*; cinnamon fern, *O. cinnamomea*; and royal fern, *O. regalis.* All are strong, stately plants, choosing moist acid soil for their habitats. They often grow 5 feet or more in height under favorable conditions. Under the drier conditions of most gardens these ferns grow about 3 feet tall. Select a damp area in the garden for the osmundas, and plant them in soil deeply mulched with oak leaves, bark, or wood chips. Allow a minimum of 3 feet between plants. All osmundas are crown formers and there will be no danger of their spreading for many years. All appear early in spring, and if kept fairly moist do not become shabby until fall.

Ostrich fern, *Matteuccia pensylvanica,* is also a crown former, but spreads by means of underground runners to form new plants. In nature it prefers an abundantly wet, marshy habitat. Kept reasonably moist in the garden it makes a beautiful stand. Because of its strong, deep root system it is especially functional where erosion is a problem, such as along the banks of a stream. Where growing conditions are ideal this species can be a rampant grower, and care must be given to its confinement.

There seems to be no limit to the selection of ferns in the intermediate-sized category. Choose some of the many shield ferns of the genus *Dryopteris*; all are crown formers and void of migratory habits. Most are about knee-high and some are evergreen, making them desirable for winter effects.

Marginal shield fern, *D. marginalis,* is a robust species and is fully evergreen. Its leaves are yellow-green in early spring and turn to dark blue-green by midsummer. This fern has a shallow rhizome-root-system and is generally found

(*Continued*)

growing in shaded rocky areas and woods.

Goldie's fern, *D. goldiana,* sometimes called giant shield fern, grows shoulder-high in nature but usually reaches about half this height in the garden. Avoid planting it in natural wind passages as the leaves are brittle and break easily. It has dark brown, heavily scale-clad croziers which appear early in the spring. This fern is not evergreen and its leaves turn brown in mid-autumn. Goldie's fern looks best when used in groups of three. For maximum protection, plant it in the shelter of a large boulder.

The two spinulose ferns, *D. spinulosa* and *D. intermedia,* with their more finely cut leaves, will remain evergreen where winters are not too severe. Common with others of the genus, they have shallow rhizome-root-systems and prefer a deeply mulched, rocky soil. Planting them beside large rocks or at the base of old stumps provide a natural setting.

Plant crested shield fern, *D. cristata,* where the soil is constantly damp. The leaves of this fern grow in an upright manner with leaflets almost horizontal.

Christmas fern, *Polystichum acrostichoides,* is fully evergreen regardless of the severity of the winter. Each spring its new white-scaled croziers uncurl amid the prostrate but still green leaves of the previous season. A dense stand of this species used on a slope will help solve an annoying erosion problem. There are many variations in the leaves such as color, size, and degree of twisting of the pinnae; these are generally caused by ecological conditions.

No shady garden should be without the native common maidenhair, *Adiantum pedatum.* This delicate, light green fern, with its arching leaves, is among the prettiest. It is not difficult to grow provided it has loose, deeply mulched soil of compost, peat moss and rotted leaves, and small stones or gravel. Keep the soil moist at all times.

The following group of ferns is often maligned because of spreading habits. When planted within confines of natural boundaries these species cause little or no problem. An occasional thinning, however, is beneficial for general wellbeing.

Hay-scented fern, *Dennstaedtia punctilobula,* has beautiful, feathery yellow-green leaves. It spreads rapidly but makes a dense ground cover and, while indifferent to soil conditions, its growth is accelerated in damp, loose soil. It is a good selection for shaded areas with dry, sandy soil where more choice ferns will not thrive. Leaves of the hay-scented fern are long lasting when cut and used in floral arrangements. In nature this fern is often found growing on rock outcroppings or among boulders, the latter location giving it the second common name of "boulder fern."

When carefully located, lady fern, *Athyrium filix-femina,* makes a delightful, cool-appearing, light green fern. There are many variations of this fern and all make good plants for the shady garden. Pink-stemmed lady fern, *A. filix-femina* var. *rubellum,* is a more colorful variation. All require a constantly moist, well-mulched area for best growth. Older leaves of lady ferns get shabby in late summer but new leaves continue to appear until frost.

New York fern, *Thelypteris noveboracensis,* is another one of the invasive species. It can be used to advantage between a woodland area and a lawn where its advancement can be controlled by either pulling or mowing. This fern is one of the first to turn brown in late summer.

Rock gardens, stone walls or ledges, already present or carefully planned and built, make excellent places to display the "miniatures." Maidenhair spleenwort, *Asplenium trichomanes,* grows best in a limestone niche or between two stones. In nature it grows on vertical faces of rocks or cliffs, thus insuring good drainage. Walking fern, *Camptosorus rhizophyllus,* is an unusual fern. In addition to propagating by spores it also reproduces by vegetative budding on the ends of the long tapering leaves. Both species are most difficult to establish, and the latter fern is an easy prey of night-prowling slugs and snails.

The little polypody or rock-cap fern

Photographs by F. Gordon Foster

Above: Ferns and epimedium are excellent companions in light to medium shade. In addition to a fine foliage effect from the two plants, epimedium contributes attractive flowers in the spring.

Right: Spinulose shield fern *(Dryopteris spinulosa)* thrives in a well mulched soil that is rocky.

Jeannette Grossman

Delicate maidenhair foliage marks a low rock wall shaded by rhododendrons.

Polypodium virginianum, is a small evergreen fern highly suited for rocky areas. In nature it is seldom found growing directly on the ground. Select a depression in a large rock or boulder and fill with leaf mold. Keep it moist but well drained until the fern gets a foothold.

There are two native bladder ferns, fragile fern, *Cystopteris fragilis,* and bulblet bladder fern, *C. bulbifera.* Fragile fern is small and easily grown in rock crevices at the edge of stone garden steps. Bulblet bladder fern prefers a higher moist-rock position to enable its long tapering leaves to gracefully hang downward. This fern reproduces by means of spores as well as small, asexual bulblets on the underside of the leaf.

Ebony spleenwort, *Asplenium platyneuron,* looks very much like a miniature Christmas fern although there is no generic relationship. It generally grows in thickets at the edges of woods and along open roadside banks. I have also seen it lining the inside of an old farmhouse well.

Grape ferns, also among the miniature plants, divide into deciduous and evergreen groups. Rattlesnake fern, *Botrychium virginianum,* and daisy leaf fern, *B. matricariaefolium,* both deciduous, are among the first ferns up in the spring. Dissected grape fern, *B. dissectum,* and multifid grape fern, *B. multifidum,* come up in July or August and are fully evergreen, the sterile leaf remaining until replaced by the new leaf the following year.

All grape ferns require a micorrhizal function in the soil and are most difficult to grow in home gardens. They can be grown when carefully transplanted from one area to another of similar soil condition. Do not expect them to grow in a new location by just transplanting them in a large clump of their native soil.

Consider some of the many hardy, exotic species for the shade garden. Two of the more colorful ones are the Japanese

Jeannette Grossman

Lady fern fronds make lacy contrast to foliage of a small-leaved rhododendron.

painted fern, *Athyrium iseanum* (*A. goeringianum*), and the Japanese pink shield fern, *Dryopteris erythrosorus*. The first is deciduous like our common lady-fern; the second is evergreen in localities having milder winters. Each leaf of Japanese painted fern ends in a graceful taper and the pinnae terminate in a similar manner. The rachis and midribs are wine red, with this color blending into the soft grey-green of the leaf. Japanese pink shield fern is of the same genus as our native shield ferns, and receives its common name from little pink shields covering the spore-bearing capsules on the underside of the leaf. The shiny, bronze-green leaves of this plant make it an unusual addition to the garden.

There are also many English horticultural variants of lady ferns, hart's-tongue fern, and shield ferns. Some of these have their pinnae ending in finger-tip tassels, others have beautiful leaves ending in crown-like tops. As to hardiness, all are about the same as their progenitors. *Athyrium filix-femina* 'Frizellae' has small, rounded pinnae alternately spaced, giving the leaf a spiral appearance. *A. filix-femina* 'Victoriae' has alternate pinnae pointing upward or downward, giving the leaf a criss-cross pattern. 'Acrocladon,' another cultivar, has brilliant green leaves and looks somewhat like a bunch of parsley.

Our native hart's-tongue fern is now virtually extinct, but the European species and many of the English cultivars will thrive in limestone settings.

Finally, build a rock garden or reserve a shaded area just for the summer to display tender, exotic house ferns that have been indoors all winter. This can be a highlight of the entire garden. The different davallias, maidenhairs, polypodys, pellaeas and others will not only enjoy and beautify your garden, but will return to winter house conditions as much healthier plants.◆

George Taloumis

Pachysandra, a durable evergreen cover.

Vinca minor growing at base of pieris.

George Taloumis

Once established, English ivy becomes a solid, evergreen ground cover.

A selection of evergreens, herbaceous perennials and wild flowers

GROUND COVERS AND HARDY FLOWERING PLANTS FOR SHADE

Andre Viette

WHAT is a ground cover? The answer often given is that it is a low, rapidly spreading, evergreen plant. But in truth, a ground cover is any plant which will cover the ground, whether its growth be by underground runners, above-ground stolons, or clumps as long as they cover the surface. Grass is the most important ground cover, but it is not suitable for most shaded areas. I have seen azaleas and rhododendrons used as very effective ground covers. Ground covers can be 4 to 5 feet high, as in cimicifuga and aruncus, or only a few inches high, as in mazus and ajuga. Foliage can be evergreen or deciduous, and flowers can be insignificant or very colorful.

Certain annuals can be planted among groups of ground covers for summer color. Bulbs also add color in plantings of monotone ground covers such as pachysandra and ivy. Daffodils and scilla and other spring bulbs are especially useful in combination with hosta, since the leaves of hosta unfold late in the spring after the bulbs have bloomed and mask the unsightly foliage of the bulbs.

Attractive mulches, such as bark, stone, hulls, can be used with ground covers which are deciduous and lose their foliage in winter, or with those which have foliage which disappears in summer, such as *Sanguinaria canadensis* (bloodroot) and *Dicentra spectabilis* (bleeding-heart). Mulches give the ground a pleasing appearance, conserve moisture and suppress weeds.

Certain ground covers are excellent for open areas which have no bounds. Ajuga, *Lamium galeobdolon*, physostegia, monarda, and lysimachia are very invading and should not be used where some semblance of order is desired. A 6-inch aluminum edging can be used to contain these rapidly spreading perennials, but eventually they will escape over it.

Such native plants as shortia, mitchella, gaultheria and galax, which have evergreen foliage, need acid soil. The plants which will tolerate more than average-moist soil conditions are: galax, shortia; athyrium, hosta, hemerocallis, myosotis, *Phlox divaricata*, mitchella and lobelia.

The following is a selection of perennial plants suitable for ground cover for the shade or in shaded flower gardens or naturalistic plantings. While many choice native plants, which grow naturally in woodlands, are included, space does not permit a complete listing. Others can be found in books devoted to this subject and in catalogs of nurseries specializing in wild flowers. Many native ferns are valuable plants for shade; see page 54 and *Plants & Gardens* HANDBOOK ON FERNS.

Height—varies as to climate, soil conditions, season, rainfall and culture; and therefore, is an approximate listing.

Color—Refers to bloom and varies with acidity, rainfall, soil conditions and the age of the plant. Usually a vigorous growing plant or a young plant will produce flowers of a lighter color.

Shade—Open shade, high shade and filtered shade are designated as light. Sun all morning, and afternoon shade would fall into this group. However, an area receiving morning shade and all-afternoon sun would be considered a sunny location. Medium or moderate shade would be that area receiving little sun through the day and is typical of a heavy oak forest. Black shade is not considered. That is a shade which occurs under maples or heavy pine forests. The problems of little sunlight, dry soil and root competition are too great to grow most plants.

Life—A plant's longevity as a ground cover or in the garden among other plants.

Foliage—Pertains to whether a plant is evergreen or deciduous.

The term **Growth** refers to the speed with which a plant will cover the ground.

Season of bloom will vary somewhat from region to region, and can also be affected by growing conditions, moisture and other factors.

PLANTS FOR SHADY CONDITIONS

Aconitum fischeri **Monkshood, Aconite**
Height: 36 inches
Color: Light blue
Season: Aug. Sept.
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate

Comments: An excellent companion for *Anemone japonica*, chrysanthemums, and other late-blooming perennials in flower borders. Prefers a rich soil, high in humus. Naturalizes well. Roots are poisonous. Subject to cyclamen mite attacks. There are other aconites, some deeper in color and earlier blooming.

Adonis amurensis **Pheasant's Eye**
Height: 12 inches
Color: Greenish-yellow
Season: March, April
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Slow-moderate

Comments: Fine-textured plant for early touch of color in shade garden. Do not not overwater. *Adonis amurensis* 'Flore-pleno' has double flowers; *A. vernalis* blooms later.

Ajuga reptans **Bugle, Bugleweed**
Height: 2 inches
Color: Blue
Season: May, June
Shade: Light
Life: Medium
Foliage: Evergreen, semi-evergreen
Growth: Fast

Comments: A leading ground cover. Spreads rapidly by stolons. Good for color contrast among rhododendrons and azaleas. Tends to die out in spots, giving seedy appearance. There are varieties with white or pink flowers, reddish or variegated foliage and other species.

Anemone japonica **Japanese Anemone, Windflower**
Height: 20 inches
Color: Rose
Season: Sept.-Oct.
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate, in clumps

Comments: Beautiful in late summer and fall flower garden. Mulch with leaves or straw in winter. *Anemone vitifolia*, 18 inches, is hardier, otherwise similar.

Anemone nemorosa **European Wood Anemone**
Height: 2 inches
Color: Blue, white
Season: May
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Moderate

Comments: One of most rewarding shade plants. Delicate in both flower and foliage. Naturalizes well. As foliage dies down in summer, tuberous begonias can be interplanted among it.

Aquilegia canadensis **Canada Columbine**
Height: 18 inches
Color: Red and yellow
Season: June
Shade: Medium
Life: Medium
Foliage: Deciduous
Growth: Moderate, in clumps

Comments: There are many other species and varieties, most of which do best in light shade.

Arisaema triphyllum **Jack-in-the-pulpit**
Height: 12 inches
Color: Green, purplish
Season: April-May
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Moderate

Comments: Early spring native for medium to even dense shade. Rich, moist soil.

Aruncus sylvester **Goatsbeard**
Height: 54 inches
Color: Cream
Season: June
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Moderate, in clumps

Comments: Large, long-lived plant for bold fernlike beauty in shade garden. Grows equally well in fairly dry woodland soil or along ponds and streams. There is a form 'Kneiffi' with finer foliage.

Asarum virginicum **Evergreen Wild-ginger**
Height: 46 inches
Color: Brownish
Season: May
Shade: Medium to deep
Life: Long
Foliage: Evergreen
Growth: Moderate

Comments: An excellent plant collected from wild under various names and often

(*Continued*)

Hybrid forms of columbine *(Aquilegia)* are suitable for partial shady gardens.

George Taloumis

Variegated goutweed *(Aegopodium)* is a useful ground cover in sun or shade.

A handsome specimen of an evergreen form of wild-ginger *(Asarum)* growing with the spreading *Phlox stolonifera,* itself a formidable ground cover for shade.

Jeannette Grossman

Bergenia, a perennial for partial shade, has evergreen foliage and pink flowers.

Martin Viette

Golden star *(Chrysogonum virginianum)*, an everblooming native American plant.

Blossoms of marsh-marigold *(Caltha palustris)* are buttercup-yellow in sun or partial shade. The plant requires damp or wet soil to survive and is dormant in summer.

listed incorrectly in catalogues. Handsome foliage, but can burn during winter in cold areas. Flowers are unimportant as ornamental feature.

Asperula odorata **Sweet Woodruff**
Height: 8 inches
Color: White
Season: May, June
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Fast
Comments: A herb whose wilted flowers and leaves have the scent of freshly cut hay and are used to flavor white wine. Fine companion for forget-me-nots and doronicum, or with shrubs and spring bulbs.

Astilbe **(hybrids)** **Astilbe, Spirea**
Height: 6 inches
Color: Various
Season: May-July
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Moderate, in clumps
Comments: There are several varieties and a few low-growing species, giving a full range of heights and color. One of the choice perennials for the shaded flower garden. Rich, moist soil is essential.

Aubrieta deltoidea **Purple Rock Cress**
Height: 4 inches
Color: Rose, lavender, red, purple
Season: April, May
Shade: Light
Life: Short
Foliage: Evergreen
Growth: Moderate, in clumps
Comments: Crevice or wall plant. Cut back after flowering.

Bergenia cordifolia **Siberian-tea**
Height: 12 inches
Color: Rose
Season: April, May
Shade: Medium
Life: Medium
Foliage: Evergreen
Growth: Large clumps
Comments: Valuable for bold effects. Winter protection needed in cold climates. Dislikes dry, sandy soil. Plant in rich, moist sites, sun or shade.

Brunnera macrophylla **Forget-me-not**
Height: 14 inches
Color: Blue
Season: May, June
Shade: Light
Life: Moderate
Foliage: Deciduous
Growth: Clumps
Comments: Sometimes listed as *Anchusa myosotidiflora.* Useful in shaded rock garden.

Caltha palustris **Marsh-marigold**
Height: 14 inches
Color: Yellow
Season: Early April
Shade: Medium
Life: Medium
Foliage: Deciduous
Growth: Moderate-fast
Comments: Prefers moist, even wet soil. Dies back in summer.

Campanula carpatica **Carpathian Bluebell**
Height: 8-10 inches
Color: Blue, white
Season: June-August
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate
Comments: There are many other bluebells suitable for light shade in rock garden or flower border.

Ceratostigma plumbaginoides **Leadwort, Plumbago**
Height: 6 inches
Color: Deep cobalt-blue
Season: August-September
Shade: Light
Life: Long
Foliage: Deciduous
Growth: Fast
Comments: Slow to start growth in spring. Flower color is exceptional.

Chelone obliqua **Turtle-head, Shellflower**
Height: 36 inches
Color: Rose-pink
Season: July-August
Shade: Light
Life: Long
Foliage: Deciduous
Growth: Moderate-fast
Comments: Needs rich, moist soil.

Chimaphila maculata **Pipsissewa**
Height: 5 inches
Color: White
Season: June-July
Shade: Medium
Life: Long
Foliage: Evergreen
Growth: Slow, spreading
Comments: Attractive plants for dry woodlands or shaded rock gardens where soil is acid. Hollylike foliage with white veinings.

Chrysogonum virginianum **Golden Star**
Height: 6 inches
Color: Yellow
Season: April-August
Shade: Light
Life: Medium
Foliage: Evergreen, semi-evergreen
Growth: Moderate-fast
Comments: Excellent for partial shade. Golden star has an exceptionally long season of bloom. Very effective in partial shade.

Cimicifuga racemosa **Black Snakeroot**
Height: 50 inches
Color: White
Season: July-August
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Clumps
Comments: Thrives in rich, fairly moist soil' Although too tall for small flower gardens, this perennial can be enjoyed in shaded shrub borders. The flowering period is a long one, and even the beadlike flower-bud stage is effective.

(*Continued*)

Convallaria majalis **Lily-of-the-valley**
Height: 8 inches
Color: White
Season: May
Shade: Light-medium
Life: Long
Foliage: Deciduous
Growth: Fast
Comments: 'Fortune's Giant' is far superior to the common form, and its foliage lasts longer into the fall season. Subject to damage by spider mites.

Cornus canadensis **Bunchberry**
Height: 6 inches
Color: White
Season: May
Shade: Medium
Life: Long, once established
Foliage: Deciduous
Growth: Moderate, spreading
Comments: A beautiful northern native, best described as a miniature flowering dogwood. Difficult except in cool sites, in acid, rich soil, but clumps can be established and will often thrive in home gardens.

Dicentra spectabilis **Bleeding-heart**
Height: 26 inches
Color: Pink-red
Season: May
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate, in large clumps
Comments: Loses its foliage in summer. *D. eximia* has rose flowers; blooms nearly all summer. *D. cucullaria* (Dutchmans-breeches), dainty plant for shaded rockery or wildflower garden, flowers in spring, then loses its foliage.

Digitalis purpurea **Foxglove**
Height: 48 inches
Color: White, rose
Season: June
Shade: Light
Life: Short
Foliage: Deciduous
Growth: Clumps
Comments: A biennial, but under some conditions, seeds itself and naturalizes. Good background plant for shaded flower border.

Dodecatheon meadia **Shooting Star**
Height: 10 inches
Color: White, pink
Season: May-June
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate
Comments: Prefers moist, acid soil.

Doronicum plantagineum **Leopards-bane**
Height: 30-36 inches
Color: Yellow
Season: May-June
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate-fast
Comments: Excellent companion for ground covers, spring bulbs and other early perennials. Becomes dormant in summer. Divide every three years after flowering. There are other species and similar named varieties.

Epigaea repens **Trailing-arbutus**
Height: 3 inches
Color: White tinged pink
Season: April-May
Shade: Light to medium
Life: Long
Foliage: Evergreen
Growth: Moderate, once established
Comments: Needs acid soil. Buy cutting-grown plants in pots. Flowers have delicious scent. Same plant family as *Rhododendron.*

Epimedium alpinum **Barrenwort**
Height: 10 inches
Color: Rose and cream
Season: April-May
Shade: Light-medium
Life: Long
Foliage: Semi-evergreen
Growth: Spreading clumps
Comments: One of the finest, long-lived perennials for shade. It requires little care and has been known to survive under maples where pachysandra and myrtle have failed. Virtually no weeds grow through a solid bed of epimedium. The flowers in spring are exquisite and lovely in flower arrangements where they can be appreciated at close range. In addition to *E. alpinum*, there are several other species and varieties of value: *E. grandiflorum* has large white flowers; *E. youngianum* var. *niveum*, white; *E. youngianum* var. *roseum* (or *violaceum* or *lilacinum*), lavender; *E. pinnatum* var. *colchicum*, yellow.

Eupatorium coelestinum **Hardy-ageratum**
Height: 36 Inches
Color: Lilac-blue, white
Season: Aug.-Oct.
Shade: Light
Life: Medium-long
Foliage: Deciduous
Growth: Fast, spreading
Comments: Needs rich soil and moisture, and can be weedy, but beautiful fall flowers justify its existence. Subject to crown rot.

Filipendula hexapetala **Meadowsweet**
Height: 36 inches
Color: White
Season: July
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate, in clumps
Comments: The double-flowered 'Flore-pleno' is usually grown. Fine plant for flower borders, poolsides, but needs rich, moist soil.

Galax aphylla **Galax**
Height: 6 inches
Color: White
Season: June
Shade: Medium
Life: Long
Foliage: Evergreen
Growth: Moderate, spreading
Comments: The foliage of galax is especially distinctive, making this plant one of best for

(*Continued*)

Jeannette Grossman

The yellow daisies of doronicum or leopard's bane, a perennial for mid-spring.

George Taloumis

Lily-of-the-valley, traditional for ground beneath shrubs, flowers in mid-spring.

The leather-textured evergreen leaves of galax and the short spikes of white flowers in early summer make it one of the best choices for medium to full shade.

Jeannette Grossman

Dicentra formosa 'Sweetheart' produces delicate heart-shaped white flowers.

Martin Viette

The silver and green leaves of *Lamium galeobdolon,* a fast-spreading perennial.

woodland gardens and other shady areas. Needs acid soil with leaf-mold or peat moss.

Gaultheria procumbens **Wintergreen**
Height: 5 inches
Color: White flowers, red berries
Season: May
Shade: Medium
Life: Long
Foliage: Evergreen
Growth: Spreading
Comments: Hardy evergreen for colonizing in rich, acid soil. Fine woodland plant.

Geranium sanguineum **Cranes-bill**
Height: 14 inches
Color: Rose
Season: June-July
Shade: Light
Life: Long
Foliage: Deciduous
Growth: Moderate, in clumps
Comments: There are many other geraniums, some for borders or rock gardens, others for woodland.

Hedera helix baltica **Baltic English Ivy**
Height: 6 inches
Shade: Medium
Life: Long
Foliage: Evergreen
Growth: Moderate-rapid
Comments: When grown as a ground cover, ivy is hardier and less subject to winter burn than when it is allowed to climb. Less hardy varieties than above will usually thrive in protected locations.

Helleborus niger **Christmas-rose**
Height: 15 inches
Color: White
Season: Dec.-Feb.
Shade: Medium.
Life: Long
Foliage: Evergreen
Growth: Slow
Comments: Needs a rich soil. Other species include Lenten-rose (*H. orientalis*). Poisonous if eaten. Fine woodland plants.

***Hemerocallis* (species and varieties) Day-lily**
Height: 20–48 inches
Color: Yellow, orange, maroon, blends
Season: May-Aug.
Shade: Light
Life: Long
Foliage: Semi-evergreen to deciduous
Growth: Moderate. in large clumps
Comments: Durable perennial for a variety of conditions. Numerous hybrids and species. Quite tolerant of many kinds of shade and soil. Can be naturalized. Indispensable for summer gardens.

Hepatica americana **Liver-leaf**
Height: 5 inches
Color: Lavender-blue
Season: April
Shade: Medium
Life: Long
Foliage: Evergreen
Growth: Moderate, clumps
Comments: Attractive woodland plants for rich soil. *H. acutiloba* is similar but has larger leaves.

Hesperis matronalis **Sweet Rocket**
Height: 36 inches
Color: White, violet
Season: June
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Clumps
Comments: The perennial form naturalizes readily and is suitable for pool or streamside, or lightly shaded areas of flower garden. Flowers are scented.

Heuchera americana **Alum-root**
Height: 36 inches
Color: Dull white
Season: June
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Clumps
Comments: Attractive for foliage clumps.

Heucherella tiarelloides
Height: 16 inches
Color: Pale pink
Season: June-July
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Clumps
Comments: Hybrid of *Heuchera* and *Tiarella*, also listed as *Heuchera tiarelloides*.

Hosta **Funkia**
(See page 42.)

Houstonia caerulea **Bluets**
Height: 2 inches
Color: White-blue
Season: May-June
Shade: Light
Life: Long
Foliage: Deciduous
Growth: Rapid, clumps
Comments: Prefers cool, moist meadows or very open woodlands. Not for hot, dry locations. *H. serpyllifolia*, a creeper for light shade; grows between flagstone.

Iris cristata **Crested Iris**
Height: 6 inches
Color: Lilac-blue
Season: May-June
Shade: Light
Life: Long
Foliage: Deciduous
Growth: Moderate to rapid
Comments: Needs fairly moist soil. Do not mulch heavily. There are other iris species which will grow in light shade. They include *I. lacustris*, a smaller form of *I. cristata;* and *I. verna*, effective in rock gardens.

Lamium maculatum **Spotted Dead Nettle**
Height: 8 inches
Color: White, rose
Season: May-July
Shade: Light to medium
Life: Long
Foliage: Semi-evergreen
Growth: Rapid, spreading clumps
Comments: Useful ground cover. *Lamium galeobdolon* has yellow flowers and is an invasive plant, but excellent where a rapid spreading ground cover is needed in shade. It has silver and green leaves and will tolerate poor soil. Common name is archangel. It grows 10 inches high in semi-vinelike manner and flowers in May.

Liriope muscari **Lily-turf**

Height: 12 inches
Color: Lilac, white
Season: Aug.-Oct.
Shade: Light
Life: Long
Foliage: Evergreen
Growth: Rapid

Comments: Rewarding ground cover for shade where hardy. Bold lilylike foliage in tufts and flowers at a time when shade area is in need of color. There are many forms, some with dark foliage or variegated.

Lobelia cardinalis **Cardinal Flower**

Height: 36 inches
Color: Scarlet
Season: July-Aug.
Shade: Light
Life: Moderate to short
Foliage: Deciduous
Growth: Clumps

Comments: Handsome native plants for open woodland or shaded poolsides. Need moist, rich soil. Fairly easy to grow from seed. *L. siphilitica,* great blue lobelia, tolerates more shade.

Lysimachia clethroides **Summer Loosestrife**

Height: 36 inches
Color: White
Season: July-Aug.
Shade: Light
Life: Long
Foliage: Deciduous
Growth: Rapid, spreading

Comments: Excellent ground cover or in areas of shaded flower border. Spreads. *L. punctata* has yellow flowers in June-July, which last over a long period; it is also spreading and may become a nuisance in flower border unless checked. *L. nummularia,* moneywort or creeping Charlie, is a creeping plant with bright green, glistening foliage and yellow flowers, and it too can become a pest, although it makes a useful cover in large areas.

Maianthemum canadense **Canada Mayflower**

Height: 4 inches
Color: White
Season: May
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Fast, spreading

Comments: Colonizing native, attractive in woodlands or under trees and shrubs, such as oaks, rhododendrons. Acid, moist soil, but tolerates average soil. Also called false lily-of-the-valley.

Mazus reptans

Height: 2 inches
Color: Lavender
Season: June-July
Shade: Light
Life: Long
Foliage: Deciduous
Growth: Rapid, creeping

Comments: One of the few plants suitable for crevices between flagstone in shade. Not always reliably hardy in very cold areas. Can become a pest in lawns.

Mitchella repens **Partridge-berry**

Height: 2 inches
Color: White flowers, red berries
Season: May
Shade: Medium
Life: Long
Foliage: Evergreen
Growlh: Rapid in favorable sites

Comments: Prefers slightly acid to neutral soil. Once established, spreads fairly rapidly.

Monarda didyma **Bee Balm, Bergamot**

Height: 36 inches
Color: Red, lavender, pink, salmon white
Season: July
Shade: Light
Life: Long
Foliage: Deciduous
Growth: Rapid, spreading

Comments: Aromatic and attractive to butterflies and hummingbirds. Useful as background in semi-shaded areas of flower borders or naturalizing along water, by walls and fences. Likes moist, rich soil, but does well enough in average garden soil. Frequent division recommended for clumps in the flower border.

Myosotis scorpioides **Forget-me-not**

Height: 6 inches
Color: Blue
Season: May-June
Shade: Light
Life: Short
Foliage: Deciduous
Growth: Spreading

Comments: Short-lived but self-sows freely in rich, moist soil. Useful by half-shaded pools, streams.

Pachysandra terminalis **Japanese Spurge**

Height: 10 inches
Color: White
Season: April
Shade: Medium to strong
Life: Long
Foliage: Evergreen
Growth: Moderate

Comments: The standard ground cover for shade, especially under trees. It is tough, hardy and durable, and for these reasons, should not be planted directly under broad-leaved evergreens as it removes moisture and food from soil. Spreads by branching rootstocks.

Phlox divaricata **Wild Blue Phlox**

Height: 12 inches
Color: Lilac-blue
Season: May-June
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate, clumps

Comments: Beautiful in flower border with tulips or in woodland or shaded rock garden.

Phlox stolonifera **Creeping Blue Phlox**

Height: 10 inches
Color: Violet-blue
Life: Medium
Foliage: Deciduous

(*Continued*)

Martin Viette

Summer-flowering clumps of the lily-turf.

Molly Adams

Bee balm will grow in sun or shade.

Jeannette Grossman

London pride *(Saxifraga umbrosa)* thrives in shade above man-made stream.

Molly Adams

The spreading plants of foamflower are a delight in woods and shaded gardens.

George Taloumis

Lungwort or Bethlehem-sage *(Pulmonaria saccharata)*, which has spotted foliage and deep blue flowers in spring, is sufficiently strong to vie with pachysandra and hosta in this partially shaded border. *Below*: The yellow flowers of a violet *(Viola glabella)* which thrives under shade of conifers in a Pacific Northwestern garden.

Jeannette Grossman

Season: April-May **Growth:** Moderate
Shade: Light
Comments: 'Blue Ridge' is offered by nurseries. An attractive ground cover, which becomes a waving sheet of blue in spring.

Podophyllum peltatum **May-apple**
Height: 12 inches **Life:** Medium
Color: White **Foliage:** Deciduous
Season: May **Growth:** Moderate, spreading
Shade: Medium
Comments: Interesting native plants for woodland and shaded corners. Roots, leaves, and seeds are poisonous, but the yellow fruit, which ripens in summer, can be eaten. White flower is fragrant.

Polemonium caeruleum **Jacobs-ladder**
Height: 15 inches **Life:** Medium
Color: Blue **Foliage:** Deciduous
Season: May-June **Growth:** Moderate, clumps
Shade: Light
Comments: Lovely perennial for foreground of flower garden or in woodlands near pink rhododendrons. Likes rich, fairly moist soil.

Polygonatum multiflorum **Solomons-seal**
Height: 30 inches **Life:** Long
Color: White **Foliage:** Deciduous
Season: May **Growth:** Moderate
Shade: Medium to deep
Comments: A fine spring-blooming plant, with pendant white flowers, and useful in woodlands or any shady garden. It prefers light to medium shade, although it will grow in extremes of full sun or very deep shade. Soil should be moist and full of humus. The foliage is delightful with other flowers in arrangements. There is a variegated foliage form, and there are native species, which are also worthwhile.

Primula **Primrose**
See page 47.

Pulmonaria angustifolia **Lungwort**
Height: 10 inches **Life:** Medium
Color: Blue, pink buds **Foliage:** Deciduous
Season: April-May **Growth:** Moderate, clumps
Shade: Light
Comments: Compact, neat habit. Attractive in foreground of flower borders. *P. saccaharata* 'Mrs. Moon' has deep pink flowers and spotted foliage.

Ranunculus aconitifolius **Fair Maids of France**
Height: 18 inches **Life:** Medium
Color: White **Foliage:** Deciduous
Season: May-July **Growth:** Moderate
Shade: Light
Comments: The double form 'Flore-pleno' is especially recommended. Also *R. acris* 'Flore-pleno' the double form of the European field buttercup, which has yellow flowers.

Sanguinaria canadensis **Bloodroot**
Height: 9 inches **Life:** Long
Color: White **Foliage:** Deciduous
Season: April **Growth:** Moderate
Shade: Medium
Comments: Usually loses its foliage in summer, especially in dry woods. An eastern woodland plant, useful for naturalizing. There is a double-flowered form. Propagate by dividing roots after flowering.

Shortia galacifolia **Oconee Bells**
Height: 8 inches **Life:** Long
Color: White **Foliage:** Evergreen
Season: May **Growth:** Slow, spreading
Shade: Medium
Comments: A choice, hardy native for rich, acid-soil woodlands and shaded pockets in a rock garden. Well worth any extra effort when clumps flower in spring. *Shortia uniflora* is the Japanese counterpart, and is generally considered more difficult, although this is an academic problem as this species is rarely listed. *Schizocodon* is a closely related genus, its species virtually unobtainable outside of Japan.

Smilacina racemosa **False-Solomons-seal**
Height: 36 inches **Life:** Medium-long
Color: White **Foliage:** Deciduous
Season: May **Growth:** Moderate, spreading
Shade: Medium
Comments: Woodland plants with handsome foliage and spikes of flowers.

Symplocarpus foetidus **Skunk-cabbage**
Height: 36 inches **Life:** Long
Color: Purple, brown **Foliage:** Deciduous
Season: March **Growth:** Moderate
Shade: Medium
Comments: This native of wetlands makes a handsome, leafy accent by shaded pools or in moist woods where it can be naturalized.

Thalictrum aquilegifolium **Meadow-rue**
Height: 36 inches **Life:** Long
Color: White, purple **Foliage:** Deciduous
Season: June-July **Growth:** Moderate
Shade: Light
Comments: Fernlike foliage and airy flowers. Other species of note: *T. glaucum*, gray foliage, fuzzy yellow flower panicles; *T.*

dipterocarpum, mauve flowers; *T. kiusianum*, choice carpeting plant with purple flowers, for light shade in rock garden. All need rich soil high in humus content.

Tiarella cordifolia **Foamflower**

Height: 8 inches
Color: White
Season: May
Shade: Light
Life: Medium
Foliage: Semi-evergreen
Growth: Fast

Comments: Spreads by runners. A fine ground cover for areas where soil moisture can be retained. *T. wherryi* is a superior plant for a shaded rock garden or woodland planting. The foliage is about 6 inches high, and the pale pink flowers reach a height of 10 inches in mid-May. It does not creep as does *T. cordifolia*, but needs same adequate soil moisture to thrive.

Trientalis borealis **American Starflower**

Height: 6 inches
Color: White
Season: May
Shade: Light to medium
Life: Moderate
Foliage: Deciduous
Growth: Moderate, spreading

Comments: Delicate woodland plants of attractive form, suitable for colonizing or for shaded rock garden.

Trillium grandiflorum **White Trillium**

Height: 12 inches
Season: May
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Moderate

Comments: A showy native to plant in woods, among ferns and shrubs, in rich, moist soil. There are many other trilliums of note. All are superior plants for the shady garden.

Trollius (Hybrids) **Globeflower**

Height: 30 inches
Color: Yellow, orange
Season: May
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate, in clumps

Comments: Need rich, moist soil. Beautiful plants in the spring flower garden.

Vancouveria hexandra **American Barrenwort**

Height: 10 inches
Color: White
Season: June-July
Shade: Medium
Life: Long
Foliage: Deciduous
Growth: Fast, creeping

Comments: Fine carpeting plant in shade. Needs acid soil rich in humus. Use peat moss or leafmold in quantity when planting.

Vinca minor **Periwinkle, Myrtle**

Height: 4 inches
Color: Blue, white
Season: May-June
Shade: Light to medium
Life: Long
Foliage: Evergreen
Growth: Moderate

Comments: Excellent ground cover, perhaps the best because it has evergreen leaves, but also effective blue (or white) flowers. Prepare the soil before planting by adding quantities of organic matter and water well until plants are established. Foliage is yellowish in too much sunshine.

***Viola* (species and varieties)** **Violet**

Height: 4-12 inches
Color: Purple-blue, white, yellow
Season: May-June
Shade: Light
Life: Medium
Foliage: Deciduous
Growth: Moderate to fast

Comments: Many, many kinds, and not all of them tolerate shade. Some may become weedy. Recommended for light shade (in moderate shade, fewer flowers are produced): *V. blanda* (white); *V. canadensis* (white); *V. labradorica* (deep violet); *V. pallens* (white); *V. priceana* (white veined with violet-blue); *V. pubescens* (yellow); *V. rugulosa* (white); *V. striata* (cream).

Waldsteinia fragarioides **Barren-strawberry**

Height: 4 inches
Color: Yellow
Season: July-Aug.
Shade: Medium
Life: Medium
Foliage: Deciduous
Growth: Moderate, creeping

Comments: Ground cover plants for shaded areas or woodlands. Rich acid soil.

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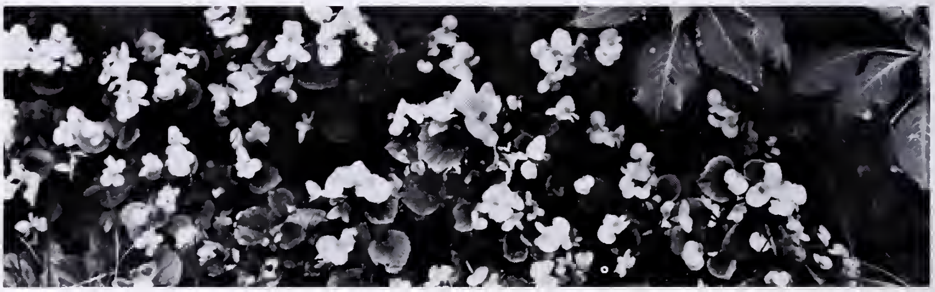

From eastern Asia and eastern North America

CHOICE PLANTS FOR THE GARDEN IN THE SHADE

Harold Epstein

A CASUAL ANALYSIS of the desirable decorative plants used in our gardens reveals our dependence upon eastern Asia, and particularly Japan, as a natural source for choice plants adaptable to our Eastern climate. It was over a hundred years ago (1859) that the renowned American botanist, Asa Gray, published his classic paper which stressed the relationship of the Japanese flora to that of the eastern United States. Since that time there has been an increasing, but slow, introduction of new and dependable garden subjects available to us. Asa Gray recognized and revealed the close affinities which exist between the two geographical areas. This relationship is dependent upon a pre-glacial land connection between Asia and North America across the Bering Sea. A study of the flora of Japan and eastern United States indicates a total of thirty common genera, including *Clethra*, *Epigaea*, *Leucothoë*, *Pachysandra* and *Shortia*.

I have experimented for over 25 years with a large number of Japanese species in my suburban New York garden. It is interesting to note that most of the common genera are adaptable to the shady garden, and some require considerable shade. There are several common genera with just two species, one in North America and another in eastern Asia.

Familiar Genera of Woodlands

Caulophyllum robustum from Japan and *C. thalictroides* from eastern North America (commonly known as blue cohosh) are very similar woodland plants of easy culture. *Diphylleia grayi* (Japan) and *D. cymosa* (eastern North America), commonly known as umbrella-leaf, are also similar plants of easy culture.

Epigaea asiatica (Japan)—This evergreen, creeping subshrub, larger in all respects than our eastern relative, *E. repens* (trailing-arbutus or May-flower defies the general rule of adaptability to our eastern lowland climate. Several attempts at cultivating it in the open garden under very shady and protected conditions have proven futile. The plants quickly become desiccated and apparently require cool conditions and a substantial winter snow cover. It has been cultivated with moderate success in some Pacific Northwest gardens, but it appears to be intolerant of our Eastern climate. It is native to open woodlands in the mountains of the northern Island of Hokkaido, as well as northern Honshu, both areas with substantial snow cover.

Our native *E. repens* is not as difficult (for it is a lowland plant), and it can be cultivated either from fresh seed or established cuttings. Young small seedlings, when collected, can be established in an acid, peaty soil, and must not be permitted to become dry until well established. It accepts considerable shade and protection.

The *Shortia* genus has been simplified in recent years. The eastern United States species, *Shortia galacifolia* (Oconee-bells) has always been thus identified except for John K. Small, who had been with the New York Botanical Garden, and who published his *Manual of the Southeastern Flora* (1933), wherein he prefers the use of the genus *Sherwoodia*. It is doubtful that other botanists have given preference to this terminology.

Shortia is a distinctive evergreen ground cover highly evaluated by most gardeners; many consider it amongst the most beautiful native plants with all-year decorative value. Even collected plants are comparatively easy to establish if provided with semi-shade, leafmold and peat moss plus moisture. The decorative foliage is particularly outstanding in winter when it takes on reddish or bronzy crimson coloring. The one-inch, bell-shaped and nodding flowers vary from white to pink and appear in spring.

The Japanese members of this genus had previously been accepted in two genera, *Shortia* and *Schizocodon.* In recent years the Japanese botanist Jisaburo Ohwi simplified this classification, so that we still have *Shortia uniflora,* with the forms of *Schizocodon* now identified as *Shortia soldanelloides.* The latter species has several varieties—form *alpina,* the dwarf alpine phase; var. *minima,* a very diminutive phase from the high mountains of Yakushima; var. *magna,* a larger-leaf type; var. *ilicifolia,* a form with rather rare small leaves with teeth on upper half, from mountain woodlands; and finally var. *intercedens,* with broad ovate leaves, narrow at tip, whitish beneath with coarse teeth, white flowers.

Personal experience as well as observation of others in the Eastern area indicates that these Japanese species and varieties are not as adaptable and hardy as the United States native. While many of the Japanese forms are in woods in the mountains, others have been observed and photographed in open alpine regions where they enjoy complete exposure to sun. Most of these areas are cool in summer, with much humidity, and winters provide substantial snow cover. This combination of elements explains the difficulty in establishing these handsome plants in the East where there are hot summers and unreliable snowcover in the winter. In the more equitable climate of the Pacific Northwest, these Japanese species appear to be more adaptable, and some impressive plantings of them have been observed in gardens in that area. In Great Britain, the general opinion is that the Japanese species are more adaptable to their climate than the American ones.

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Asiatic twin-leaf (*Plagiorhegma dubia*).

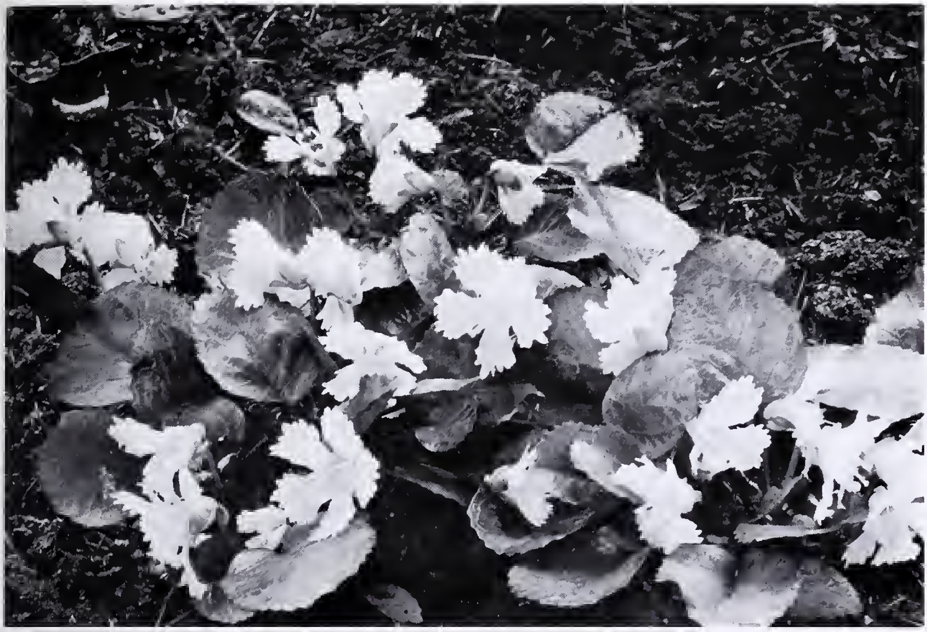
Plagiorhegma diphylla — This eastern U.S. native is more commonly known by its less cumbersome genus of *Jeffersonia* (twin-leaf). It is an easy plant with distinctive foliage, deeply cleft into two lobes producing individual one-inch white flowers in March or April.

Plagiorhegma dubia is the only other species, and is native to Manchurian woods, indicating a remarkable geographical distribution for this genus. This is the more beautiful plant, large lavender-blue flowers following the unfolding metallic blue-green leaves in early April. The foliage gradually turns green as it matures. Both species self-sow when planted in proper woodland conditions, humus-enriched soil which retains moisture.

In the study of the comparative flora of eastern Asia and eastern North America, there are other genera distributed within and outside Japan, which have also proven to be choice plants adaptable to our climate. The following are some that are particularly desirable for shade.

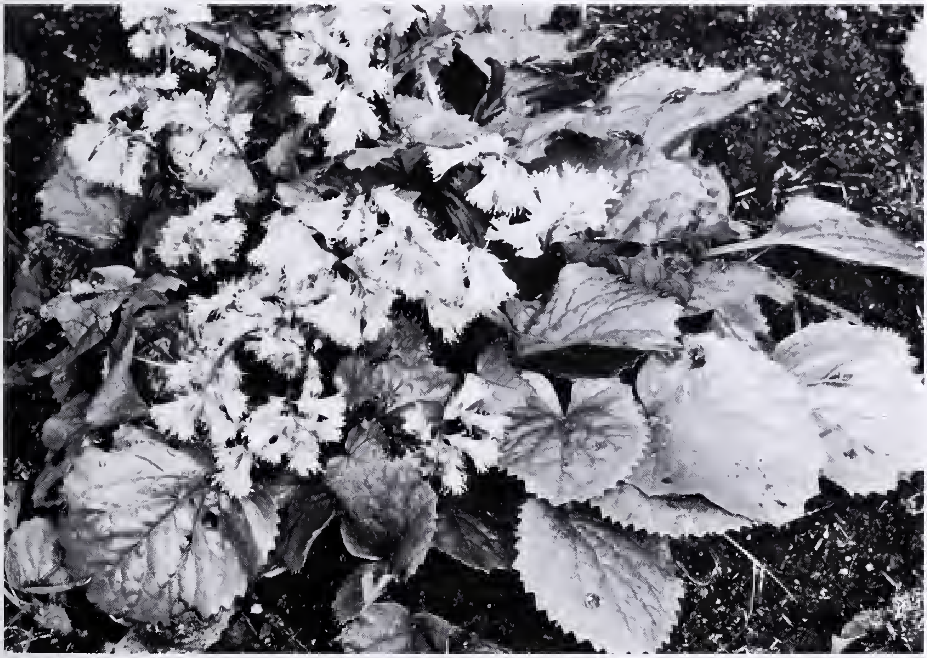
Pachysandra procumbens

This native from southeast United States, although introduced into cultivation in 1800 and described and illustrated in color in the Botanical Register in its first volume in 1815, is not well known

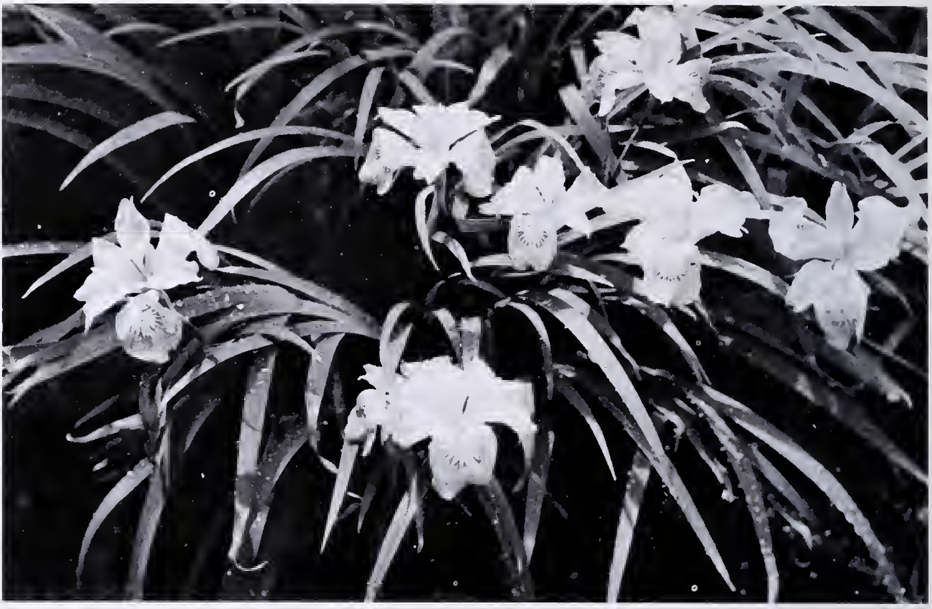


Photographs by Jeannette Grossman

Shortia uniflora, an Asiatic species, has evergreen leaves and white to pink flowers.



Schizocodon soldanelloides, with fringed flowers, is often classified as *Shortia*.



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Iris gracilipes is a Japanese species suitable for woods and shaded rock gardens.

nor readily available. Its description varies from semi-herbaceous to semi-woody or half-evergreen, but in the New York suburbs the foliage is usually mutilated by winter conditions, and thus should be sheared in early spring before the new growth emerges. The foliage is dull and slightly pubescent, and is clustered at the top of the 8-to-12-inch stem. The 4-inch flower stalk is produced from the base of the stem. Although a coarse ground cover, it is useful even in deep shade and under adverse conditions. Its best demonstrated use is as an extensive, lush ground cover under the low-hanging branches of a huge beech tree—always a difficult area where there are few possible candidates for an effective long-lived candidates for an effective planting.

Pachysandra terminalis

First introduced into Europe in 1882 from Japan where it is widely distributed in woods in lowlands and low mountains in all the five major islands. The wide use of this coarse plant with its evergreen foliage is familiar to most gardeners in the East, where it is used so extensively and is perhaps the most overused ground cover. Its varying uses are easily demonstrated by a drive through the suburban areas. But it is interesting to note that at great contrast to its popularity and adaptability here, there has not been extensive use of it in Great Britain and on the Continent. Even in Japan the average small garden cannot cope with this aggressive plants, which can eventually overtake and smother its near companion.

Although the records indicate about five species of this genus, the only other known in cultivation is *P. axillaris,* a native of China and introduced in 1901 by E. H. Wilson. Although an evergreen, it does not retain this condition in our climate. Experience has proven that it is a much slower grower here, and the foliage is usually damaged in winter even if in deep shade and protection.

Iris gracilipes

This iris is native to mountain areas from the southern to northern islands of Japan. The huge *Iris* genus is divided into eleven groups, each with common characters. One is the Evansia group and includes this choice Japanese species, as well as two eastern U.S. species which are also being mentioned. This group was named after Thomas Evans, who introduced the tallest, *I. japonica,* which is questionably hardy. *Iris gracilipes* forms a slender, creeping rhizome with fan-shaped leaves 10 inches long. From this dense neat foliage appear branched and wiry stems, bearing dainty round flowers of pale lilac with orange crests. It is a plant for partial shade, appreciating an open woodland soil. It is a fine companion with the following two species.

Iris cristata

This is the eastern U.S. species in the Evansia group. It is more spreading in habit and is excellent for retaining shady slopes. It is smaller in stature than the preceding species, with wider and shorter foliage. The single flowers on 6-inch stems vary in shades of lilac blue or mauve, and occasionally a deeper color form is available. It is an excellent ground cover for partial shade and will multiply rapidly in light woodland soil.

Iris lacustris is native to shores of the Great Lakes, which still makes it an Eastern species. It is the most diminutive of the three. Resembling a miniature form of *I. cristata,* it was for a period considered a variety of it, but it is definitely a separate species. The similar flowers are individually borne an inch or two high. There is also some color variation in these appealing flowers. Cultivation should be in sandy or gritty soil with some humus. All three of the described iris have albino forms, which are generally available, except for *I. lacustris alba,* a comparatively rare form and seldom offered in the nursery trade.

Saxifrages for Shade

The saxifrage family includes over 300 species with widely varying cultural requirements. This genus is divided into about 16 different sections; the one deserving attention here is the Diptera group. It has been selected because of the adaptability of most of its species to shade gardening. The group consists of only about six species, all native to China and Japan. No North American species are represented. All the following Japanese species have proven dependable in this area for the shady garden.

Saxifraga stolonifera has been known erroneously as *S. sarmentosa,* with the vernacular names of mother-of-thousands, Aaron's beard, strawberry-geranium and others. The species was first introduced into cultivation from China in the late 18th century and during all the intervening years, it has been cultivated primarily as a house plant. Many garden visitors here appear startled to observe the plant spreading on moss-covered rocks along pools, and its ability to endure the winter climate. This type of habitat is similar to its native conditions in Japan. It may also be used as a spreading ground cover in damp shady woodlands. The round marbled foliage is variable in coloring. It produces numerous creeping red stolons bearing young plants which easily root into available moss, open soil or crevices. The 10- to 12-inch branching flower spikes of mid-summer bear quantities of attractive white, irregularly shaped petals with some red spotting.

Marjorie Dietz

Saxifraga fortunei in Harold Epstein's garden, photographed in November.

© *Roy Elliot*

Cup-shaped blooms of *Glaucidium palmatum,* a native of northern Japan.

Saxifraga fortunei, while native to various Japanese mountain areas, also spreads into Korea, Manchuria and China. It is a very hardy deciduous plant, forming clumps without stolons, preferring shady protected areas. It has handsome large, glossy leathery foliage with the reverse a deep maroon. Its 12- to 15-inch flower spike, produced in October, bears pure white, irregular petalled flowers. An unusual form under various names 'Rubrifolia,' 'Purpurea,' etc. has magnificent ruby red foliage and is as hardy as the type.

Saxifraga cortusifolia, also from Japan, resembles *S. fortunei,* but does not have the underleaf maroon coloring. The foliage has longer and denser hairs, and is usually deeply cleft. It has similar growth and cultural habit, but precedes the former species in bloom by about a month.

The nativity of *Saxifraga cortusifolia* is in question; some references state China and others Japan, but apparently it is an Asian species. This plant may be described as a diminutive form of *S. stolonifera* with similar variegated coloring and stoloniferous habit. The flower structure is also reduced in size with 3-inch spikes. It is definitely an indoor plant in this climate (or even in more temperate areas), for repeated efforts to cultivate it outdoors with various protecting means have proved unsuccessful. A cool greenhouse is its ideal winter home.

Saxifraga veitchiana is another member of the Diptera group, a native of Hupeh in China. The roundish 1½-inch foliage is fleshy and dark green. It is also a stoloniferous plant, producing a dense ground cover in partial shade. It has been extremely hardy, requiring no protection or coddling. The 6- to 9-inch flower panicle, produced in late summer, has the typical irregular petals, pure white.

Primula sieboldii

In a genus of over 200 species throughout the world (primarily in the Northern Hemisphere), Japan is only represented by 13 species. Of these, the most adaptable to our Eastern climate is the very variable *P. sieboldii.* It has proven to be the most permanent of all primrose species and hybrids, tolerating all extremes of this area. Its defensive habit of shedding its foliage when dry or attacked by red spider, and retaining its underground creeping rhizomes, is the secret of its long life and ease of increase. If there were to be a choice of only one primula species for this garden, this is the selected one.

In Japan there is a specialized plant society devoted only to this species, and entire spring shows display many variations of form, color and size. In fact, there are hundreds of named varieties grown by Japanese specialists of this species. The plant has soft crinkled foliage from which rise 8- to 10-inch flower spikes. These run the gamut from pure white, pink, rose, lavender, to bluish, but not yellow. The outlines of the petals are as variable as snow flakes. It may be of interest to note that double forms have not been introduced. Its cultural requirements are simple—part shade, moist root run and care in not disturbing the dormant rhizomes. Where conditions are satisfactory, self-sown seedlings will appear. Propagation from seed usually produces a variable group of interesting plants.

Menziesia purpurea

Japan contains an enormous collection of deciduous and evergreen ericaceous plants. A lesser-known genus is *Menziesia,* which contains about seven species, all deciduous. Four are in Japan, two in western North America, and one in eastern United States. The American species are not impressive and certainly not garden worthy when compared with those of Japan, which are beautiful plants of slow growth and deserving of representation in any collection. The Japanese species selected for description is undoubtedly the finest, and is not too different from *M. ciliicalyx* (and its varieties), the latter usually being the more dwarf. Other differences are basically botanical. Either species, when available, is worthy of acquisition. The plants and flowers resemble the better-known, closely related genus, *Enkianthus,* but the species of *Menziesia* are more dwarf and slower growers. The urn-shaped flowers of both are in drooping terminal clusters. *M. purpurea* has rich red to deep purple flowers. Its scarcity in commercial channels is regretted and should be corrected.

Leucothoë keiskei

The hardy species of *Leucothoë* are represented in Japan, and both the eastern and western United States. But this selected dwarf Japanese mountain plant has the largest flowers of all the hardy species. It is a beautiful and distinct low, procumbent evergreen shrub with smooth red young wood and glossy bright green foliage. The flowers produced in July are pure white cylinders, ½ to ¾ inch long by ¼ inch wide, in terminal drooping clusters. It is advisable to plant this species in peaty woodland soil in considerable shade, preferably with a western to northwestern exposure in order to avoid leaf desiccation from cold winter winds. There is also a more diminutive form of this species, but is seldom available.

Arcterica nana

This is a monotypic ericaceous genus which has been previously classified as in *Andromeda, Pieris* and *Cassiope.* It is a diminutive Asiatic shrublet, ranging from northern Japan and areas farther north. It has dense, wiry stems with dark glossy green, leathery leaves. The fragrant flowers are white, roundish urns in terminal clusters of three or four, and open in late April or May. It succeeds in acid, peaty soil and partial shade, and ordinarily is not difficult. It is the perfect plant for the small, shady rock garden, where it can never become a nuisance. Again it is not commonly available.

© *Roy Elliot*

Arcterica nana, a dwarf evergreen shrub of the heath family.

Plants Native Only to Japan

In contrast to the preceding there are a number of endemic herbaceous genera in the temperate areas of Japan which are not found elsewhere. They are all worthy plants, ideal for our gardens particularly in shade.

Anemonopsis macrophylla

This distinctive species is comparatively rare in mountain woods on Honshu, the major island of Japan. It is an elegant plant, with foliage resembling cimicifuga and with racemes, about 18 inches high, bearing nodding flowers of a waxy texture and icy lavender-blue color. It has proven adaptable to a variety of situations in deep or light shade, and in woodland soil containing much humus—peat moss—to retain moisture. It commences flowering in August and continues through September. It is an easy perennial, long lived and readily (but slowly) grown from seed.

Deinanthe bifida

This Japanese endemic species grows in mountain woodlands in the warmer areas but is dependably hardy in the New York region. It has creeping rhizomes with erect leafy stems up to 2 feet, which bear waxy white flowers in July and August. It prospers in a shaded woodland area among low shrubs.

There is only one other species in eastern Asia, *Deinanthe coerulea,* introduced into cultivation by E. H. Wilson, who sent seed from Hupeh in China. This is another shade-loving woodland plant thriving in damp, peaty woodland soil. It grows to about 12 inches high with foliage like a hydrangea, producing magnificent, lilac-blue nodding and cup-shaped flowers in July and August. Both species have proven hardy for many years in the New York area.

Glaucidium palmatum

This is a distinctive monotypic plant of woods and thickets in high mountains of northern Japan. Being deciduous, its handsome bold foliage rises from the soil in April, gradually unfolding and producing the tight flower buds. The open cup-shaped flowers, 4 to 5 inches in diameter, have a satiny sheen and are lilac blue in color, shading into white in the center, and set off by a large cluster of golden stamens which enhances the beauty of this wonderful plant. The fully unfolded leaves are broadly palmate and dissected into seven sharply toothed lobes. After fertilization, the flower sets two large bean-like pods containing flat winged seeds, which usually take two years to germinate. The leaves and seed pods do not ripen in very shaded areas until late October. There is a magnificent pure white form exceedingly rare, and which warrants all effort to locate.

Hakonechloa macra

This monotypic perennial grass, which also has been known as *Phragmites macra,* is seldom seen outside Japan. It has creeping rhizomes with leaf blades from 6 to 10 inches long. It occurs on wet, rocky cliffs in mountains and is rather rare. Its variegated forms are cultivated as ornamental pot plants. In the garden it is an interesting accent in a mixed border and can be used to brighten a shady corner.

Kirengeshoma palmata

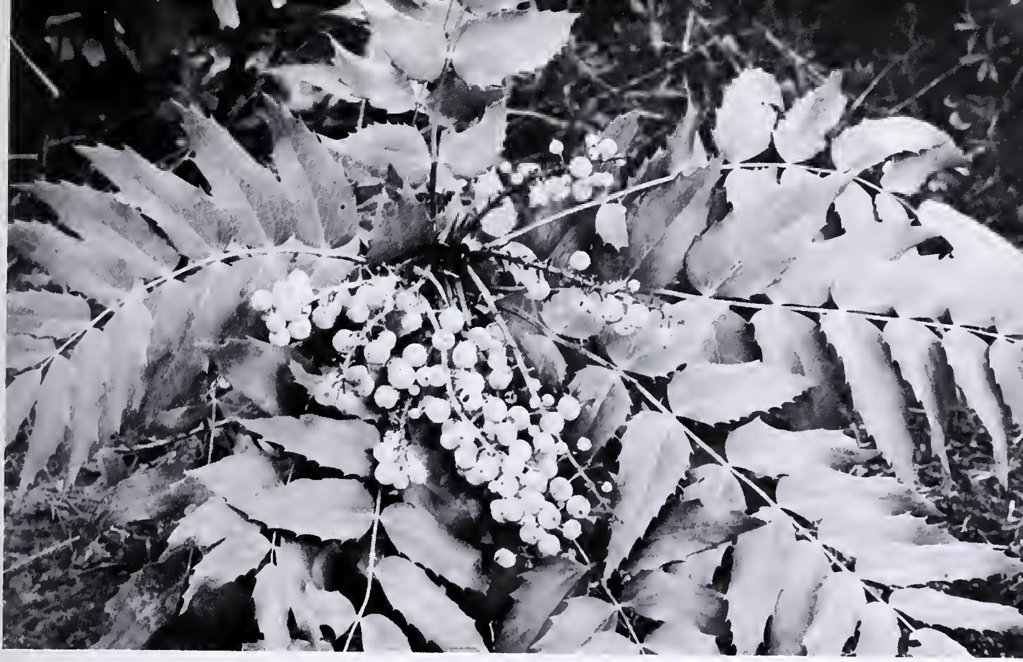
Here is another woodland plant of the mountains well suited for a shady slope. Its somewhat palmate leaves are large for the 3-foot plant. The flowers, which slowly emerge in August, persist for several weeks, and are 2-inch waxy yellow, pendent bells of great charm. It is an easy, long-lived shade plant, easily propagated by division, cuttings and seed. Why has such a dramatic plant remained so rare?

Tanakaea radicans

This evergreen perennial is not completely endemic to Japan as it does spread into China. It is comparatively rare in its native habitat, wet, shady rocks where it gradually covers the moss and soil with its delicate growth. The leaves, pointed, toothed, deep green and leathery, produce erect white plumes of flowers, about 5 inches high, and indicate its close relationship to the astilbes. From each crown, fine stolons or runners emerge, and small plants are then produced from their tips, so that there is a slow radiating increase of this dainty ground cover. The growth is not excessive because of its size and slow rate of increase. It is an ideal plant when placed in the shade produced by choice, small ericaceous plants.

These choice Japanese and Asiatic herbaceous and woody plants are only a small sampling of the jewels available from that area of the world for the shady garden. Are there not sufficient keen and selective gardeners who appreciate these treasures of nature? Why do the introduction and commercial availability of the finer species require generations before being acknowledged and offered? In 1911 Reginald Farrer, the English dean of rock gardening, stated in his book *My Rock Garden* the following:

"*Saxifraga fortunei* is a singularly beautiful species, far too little cultivated." This was expressed 58 years ago and, while many of the recommended species are available in Great Britain, where can they be procured in the United States? ◆



Jeannette Grossman

Foliage pattern and fruit of *Mahonia* as shown by *M. nervosa,* a western species.

TREES AND SHRUBS FOR SPECIAL EFFECTS

Frederick McGourty, Jr.

GARDENERS who are very fond of showy flowering shrubs and trees are often disappointed with shady gardens, but there are several blessings to such sites. Actually, the flowering time of most woody plants is only about ten days a year, depending on weather conditions. Unfortunately, many of the commonly planted flowering trees and shrubs, which usually require full or nearly full sun, have little merit aside from their blooms. This means that about 355 days of the year are frequently endured with a monotonous landscape.

Yet, some of the plants that are attractive year-round are not especially ornamental in flower. When leaf texture, twig color and bark character are considered, the horizons of the shady garden widen. A number of broad-leaved evergreens, including ones of border-line hardiness, come to their best in gardens that receive some winter shade, and most variegated plants, which can provide flower-like relief in deep green areas of the garden, can be grown well only in partial shade in areas of the country where the summer sun is severe.

For brilliant stem color in winter, when gardens are often drab, the Siberian dogwood (*Cornus alba* 'Sibirica') and yellow-twig dogwood (*C. sericea* 'Flaviramea') can brighten northern gardens that are shaded by deciduous trees. These shrubs are most attractive in snow, but they should be pruned severely in early spring to assure vigorous new growth. It is only the young wood of the previous season or two that is vividly colored. *Kerria japonica,* a green-twig shrub that blooms well in substantial shade may serve as a good complement to the dogwoods for a winter effect. The etiolated growth common to shady areas may be

Marjorie Dietz

The winter-hazels *(Corylopsis),* shade-tolerant shrubs, have drooping yellow flowers before the foliage unfurls.

Genereux

Foliage of shrubs in witch-hazel family can be decorative in light shade. Shown is winter-blooming *Hamamelis mollis.*

turned to advantage with these shrubs.

The cinnamon-colored bark of two species of *Clethra, C. acuminata* and *C. barbinervis,* is most attractive in winter. Both are hardy as far north as New England. These large-growing shrubs or small trees have more character than the summer-sweet (*C. alnifolia*), which is often grown in shady gardens for its fragrant flowers. The latter has undistinguished stems and becomes leggy unless the old wood is cut out from the base periodically.

The striped-bark maple (*Acer pensylvanicum*) is not common in gardens, but its winter effect can be superb in the cool northern states. This tree of small eventual height thrives in shady spots in woodsy soil. The more vigorously it grows, the more pronounced the green and white striped bark will be.

One of the most distinctive tall growing shrubs for twig character is the winged euonymus (*Euonymus alatus*). While its flowers are inconspicuous, it is shade-tolerant, and the winged stems do not appear as pronounced in the compact form ('Compactus'), which makes a fine hedge where euonymus scale is not a problem. Burning-bush is an appropriate name for this plant, for the autumn color is probably the most intense red of any hardy shrub.

Apart from rhododendrons and the many varieties of azaleas that retain their foliage over winter, there are numerous broad-leaved evergreens that grow well in the North with some winter shade. While in the South some of the following shrubs may appear at their best in full sun, they are best grown in the New York area in some winter shade to minimize tip injury. A brief list of border-line species on Long Island benefiting from shade would include *Aucuba japonica, Camellia japonica,* English holly (*Ilex aquifolium*), Chinese holly (*I. cornuta*), Japanese privet (*Ligustrum japonicum*), glossy privet (*L. lucidum*) and *Osmanthus heterophyllus* (*ilicifolius*). This list becomes more impressive when one remembers that there are a large number of garden varieties of each of these plants.

Even Japanese holly (*Ilex crenata*), which is rather dependably hardy in New York City, may occasionally suffer winter leaf injury if planted in full sun. This is especially true of *I.c.* 'Convexa.' The evergreen Oregon-grape (*Mahonia aquifolium*) and its relatives demand a good degree of shade in the colder months here. Some of the evergreen barberries (*Berberis julianae, B. triacanthophora* and *B. verruculosa*) also appear to grow best in some shade, at least until they are fully established.

Mention should be given Reeves skimmia (*Skimmia reevesiana*), a low-growing member of the citrus family. Under the dense shade of Austrian pines in the Rock Garden at the Brooklyn Botanic Garden, this shrub, used as ground cover, always attracts attention. For a good part of the year it has red holly-like fruit. The somewhat taller-growing *Skimmia japonica,* which is only slightly less desirable because it is dioecious, also benefits from shade. When grown in full sun, these shrubs will often suffer winter injury in New York.

Shrubs and trees with variegated foliage are more popular in England and in the Pacific Northwest than they are in the Northeast. One reason for this may be climatic, since the relatively weak rays of the sun in more evenly moist climates permits these plants to be grown under a variety of circumstances. In the Northeast, unless variegated shrubs are given partial shade, their leaves frequently burn. While their excessive use can be hideous, an occasional planting in a shaded area may provide much needed contrast—almost a flowering effect. Among the best woody plants with variegated leaves are *Kerria japonica* 'Picta,' tricolor dogwood (*Cornus florida* 'Welchii'), silver-edged shrubby dogwood (*C. alba* 'Argenteo-marginata'), the Drummond or Harlequin form of Norway maple (*Acer platanoides* 'Drummondii'), tricolor beech (*Fagus sylvatica* 'Tricolor') and gold-dust shrub (*Aucuba japonica* 'Variegata'). The last is often grown as a house plant, but it is hardy outdoors in a shaded spot as far north as N.Y. City.

Jeannette Grossman

For a contrast in foliage effect: *Sarcococca hookeriana,* hardy through Zone 7.

Several members of the witch-hazel family are valuable in shady gardens for their distinctive foliage as well as their flowers. *Corylopsis pauciflora,* a dense low-growing shrub, has delicately pleated leaves, while the taller (to about 6 feet or so) *Corylopsis sinensis,* which has an open growth habit, has leaves with a bluish cast. Both have yellow flowers about the time forsythia is in bloom. *Fothergilla gardenii,* to 3 feet, and the taller *Fothergilla major* have leaves that somewhat resemble witch-hazel. The autumn coloration is often a fine red, while the flowers, which look like small bottle-brushes, are attractive in partly shaded areas of the garden in early May.

Occasionally, a coarse leaf effect may be desired to break the monotony of a shady spot. Oak-leaf hydrangea (*Hydrangea quercifolia*), leather-leaf mahonia (*Mahonia bealei*) and leather-leaf viburnum (*Viburnum rhytidophyllum*) can provide a good contrast when planted with narrow-leaved shrubs. Among the latter might be the weeping English yew (*Taxus baccata* 'Repandens'), dwarf Japanese yew (*Taxus cuspidata nana*) or shrubby forms of common hemlock (*Tsuga canadensis*). ◆

Roche

The flowering dogwood tree is a favorite ornamental for shade near buildings.

A personal selection of trees to provide shade for streets and home grounds . . .

SHADE AND ORNAMENTAL TREES

Richard Walter

TO ONE who has spent many years in a suburban community as a municipal arborist, garden adviser, teacher and patient listener to garden problems, the list of tree worries seems to be endless and so often a convenient place to put all sorts of garden failures to rest. Over the years I have become very critical about the selection and use of trees, not only by municipal tree planters, but also by those who plant on private property.

Light to medium shade can be very desirable and beneficial to our gardens and for our comfort. When trees, by their numbers, by the density of the shade they cast and by their root activity, make it impossible for other plant material to thrive under or near them, then the trees become the destroying agents of our gardens and the real estate they represent. In every municipality, such hopeless and degenerating gardens can be found. When they multiply, the desirability and values drop with all the symptoms of a declining neighborhood.

Most people are naturally sentimental about trees and hesitate to accuse trees of robbing them of the full enjoyment of their gardens. Actually nature never created a bad tree but assigned each one to its specific place. So the trouble is caused by those who select and plant trees, and when mistakes are made, they last a long time and the expenses to correct them grow with the trees.

Tree selection and planting are a serious business. Of course, it is not always the killing shade which causes other plant life to fail under trees. Shallow and aggressive root systems of some species do this very effectively. A few, like the black walnut, may even poison the soil for many other plants. Then the depletion of nutrients, of decomposable organic matter, diminishing water-holding capacity, and soil compaction can destroy most other plants under the trees. But most often a combination of these evils will lead to an abandoned garden. Yet shade—the right amount of it—from high branches and deep-rooted trees can lend much to the full enjoyment of a garden and to the environment of a community. When those trees are further enhanced by showy flowers, fruits or foliage, then they become a gardener's delight. What gardener does not dream of having once the opportunity to plant the right trees in the right places ideal for sun-loving and shade-loving plants, for roses and rhododendrons, for chrysanthemums and ferns.

Too often when this opportunity arises for the home gardener or the town planter they panic and plant for quick shade and the most shade. They plant fast-growing, shallow-rooted, and heavy shading trees and plant five where one should be enough.

Among the wide selection of desirable, amenable trees are those of large, medium and small sizes. The spacing of trees is best determined by getting acquainted with the average mature spread of the particular species or variety. This spread, plus a little extra for the sun to reach down into the garden, becomes the guide line for spacing. Thus sugar maple, with an average spread of 40 feet should be given at least 50-60 feet of spacing, a red or white oak, 60-70 feet, while small trees, like Siberian crab apple, dogwood, hawthorn rarely spread over 25 feet and can be spaced 30-35 feet apart. A backyard of about 50 by 50 feet cannot have two or more large trees, but it have one large and two or three trees. It is almost the rule in street tree planting to find on a 50-foot frontage, two maples or lindens or planes or pin oaks, naturally with disastrous results to plantings, utility installations, sidewalks and curbs.

A trick to make many of the small trees more suitable as flowering shade trees is a practice known as form-training. This is pruning back of the lower side branches. As the young tree grows either in the nursery or at the planting site, this pruning is continued until a sturdy trunk is formed 6-8 feet high and the crown is shaped. Then all stubs of the former lower side branches are removed. A dogwood, hawthorn or crab apple can be form-trained into a flowering shade tree. Arboretums and display gardens often show such trees as they naturally grow, like oversized shrubs, unpruned, unshaped, with very little practical garden use. Fine examples of this form-training are the American holly trees on the terrace at Longwood Gardens.

Small flowering trees, trained by pruning into standard trees, are becoming very popular for mall and street planting, and are equally well suited for home gardens. Certainly one man's opinion must never be used as a sole yard stick here, but it can serve as a starting point in tree evaluation. First consideration in tree selection is tolerance to soil conditions and compatability towards other plants under or near it; then its behavior above and below ground in relation to structures and installations; depth of root systems; ornamental value; structural strength; resistance to insects and diseases; litter problem and recovery from transplanting. Least important should be cost. Some trees have more desirable qualities than others. The space in a garden is valuable and only the best qualified plants should be chosen.

Large Shade Trees

Oaks: Most tolerant, and top selections are the red, scarlet, black and white oaks, if given proper spacing and lower branches are removed. Lesser known is the saw tooth oak, very open headed, tolerant to various soil conditions and compatible with other plants. Least wanted is the pin oak, *Quercus palustris* and the similar willow oak. Both are shallow-rooted and, therefore, not compatible to other plants. They rate as high-maintenance trees.

Maples: Among them the sugar maple is truly a magnificent tree where space is adequate. Deep rooted, compatible with other plants if lower branches are removed to a height of 12-15 feet. CAUTION: Sugar maples will not tolerate poorly drained, compacted soils or polluted air. *Acer rubrum,* the red maple, deserves consideration as a lawn tree, though it is shallow-rooted and less compatible with other plants. The nursery trade offers several selected clones with improved autumn color, conical and narrow columnar forms. These varied selections of red maple plus tolerance for thriving on shallow soil often make them a good choice. Least compatible to other plants are the many forms of the Norway maples, except the columnar form. For the same reason one should be critical of silver maple, plane-tree maple, and box-elder, except perhaps on seashore or city locations, where other trees have a difficult time.

Honey Locust: Much credit should be given to the nurserymen who now offer improved clones of honey locust far superior to the species. These honey locusts are large trees, both in spread and height, and are very compatible to other plants, as well as tolerant to soil and location and cause very little litter. However, there are no showy features of flowers, fruit or autumn color and there can be troubles from pests. It also appears that these honey locusts will be overplanted for the same reasons as are Norway maples, pin oaks or plane trees and that is, easy and quick nursery propagation and quick recovery after transplanting.

I dare here to list the black locust (*Robinia*) as a ruggedly, beautiful native tree. Its faults are a poor root system, ground suckering, which we combat by treating the stubs with 2,4-D, and pests. Its place is in mixed screen plantings on banks or marginal planting areas.

Elms: Some day we all hope to plant the American elm again as it is the finest large tree. Its cousin, the zelkova, is hardly a substitute, although it is a neat, open-headed tree to supply light shade. It is resistant to Dutch elm disease, but not the elm leaf beetle.

Yellow-wood: A most beautiful and little-known native, big tree, yellow-wood (*Cladrastis lutea*) is deep rooted and compatible to other plants if lower branches are removed. Tolerant to poor soil, but recovery from transplanting can be a little slow. It is best moved in the spring with a root ball. A little patience and skill are needed in the nursery and later, on the planting site, to shape it to standard tree form. This difficulty may also account for its unpopularity with nurserymen. Select a planting site for its ultimate size of approximately a 30-40 foot spread and height of about 50-60 feet. It does make a big tree.

Callery Pear (Pyrus calleryana): A very popular newcomer in the medium-to-large range; valuable as a street and park tree and highly recommended for home gardens. Our first plantings, about 20 years old, are nearly 30 feet high with 10-12-inch diameter trunks. Very deep rooted, compatible and soil-tolerant, almost pest free, good foliage, showy with its white flowers and autumn color. The clone 'Bradford' is nearly non-fruiting. Our seedling selections produce some fruit less than ½ inch in diameter, which are readily taken by birds during the winter months. It will grow to 40 feet in height and has a 30-foot spread.

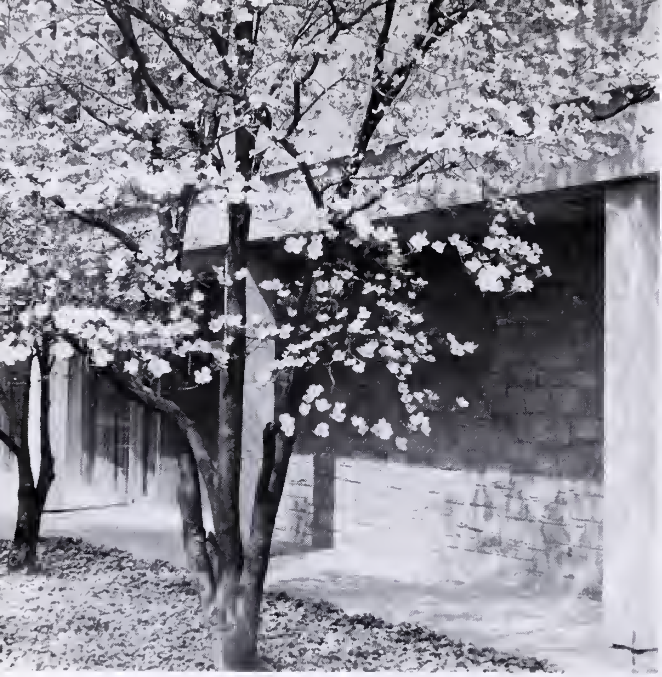
Scholar Tree (Sophora japonica): Under favorable growing conditions and in about 50 years, this tree can reach a height of 60-70 feet and spread of 40 feet. Travelers through France in August can spot it by the white clouds of flowers reaching over the tree line of villages and towns. It is very compatible towards other plants, light shade, and is deep rooted and showy. Pest-free but sensitive to wet,

George Taloumis

The flowering dogwood is one of the most versatile of small trees for home landscaping. Here white blossoms gleam against dark hemlock background. Later, in full leaf, trees cast light shade.

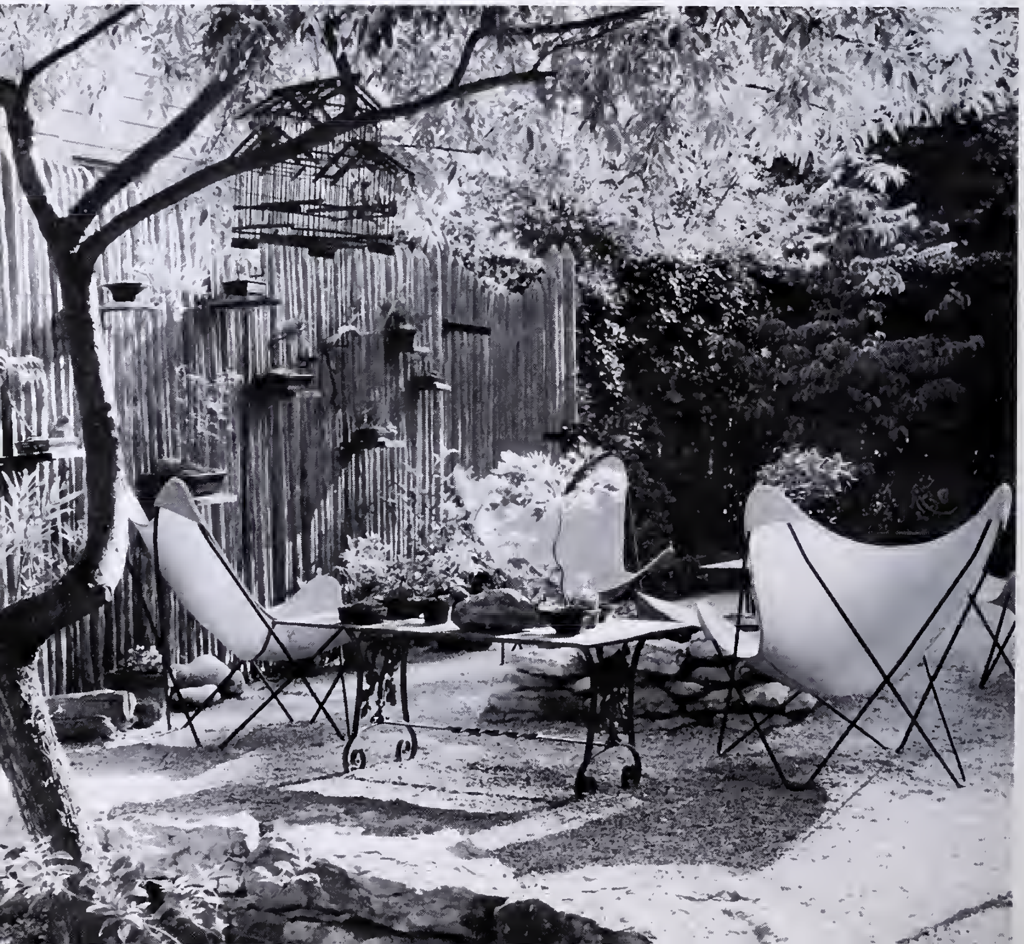
Arthur Norman Orans

Shade of the vanishing American elm.



The shading value of many small trees can be greatly improved by regular pruning when the trees are young. *Left*: The lower limbs of these flowering dogwoods have been removed to make the trees more suitable for the site. *Below:* A single tree has been trained by pruning to become an artistic as well as practical source of shade for this backyard terrace.

Roche



shallow, compacted and sour soil conditions with die-back or total loss of the trees often resulting. CAUTION: Flower and fruit litter can become a nuisance. Plant away from heavily used walks or patios.

Metasequoia (or Dawn-redwood): A non-evergreen conifer and the most exciting and most promising of the newer introduced trees for streets, parks and home gardens. Most significant is the fact that the heavy and irregular butt swelling of this tree almost never appears when it is grown as a standard tree with the lower branches removed in the nursery or in the planting site to a height of 7-9 feet. Deep rooted, very compatible and tolerant. No leaf litter and good yellow autumn color; it can be pruned and shaped at will and transplants readily bare root, either in fall or spring. Recovery and growth are rapid. It may tend to be over-flexible while young, but will become sturdy and strong as it matures. It is a big tree and should reach 50 or more feet with a 25-30-foot spread.

The Smaller Trees

With properties becoming smaller, tree-growing spaces on the streets steadily shrinking and tree care getting more expensive, the search is on for smaller trees as shown by the widening choices in nursery catalogs. These trees are difficult and costly to produce, are usually in short supply, and may have to be ordered years ahead of delivery.

Crab apples: Only the Siberian crab apple, *Malus baccata,* has qualifications as a flowering shade tree both for street planting and for home landscaping. It shapes readily into a well-formed standard tree with trunk height of 7-8 feet. Height and spread are within about 30 feet. The root system is deep and strong, the tree is compatible and soil-tolerant, with no insects and disease problems. Flowers are white to pink and profuse. CAUTION: Select or purchase only available selections with fruit less than ½ inch in diameter. Here, as in the case of the Callery pear, the breakoff point in fruit size is ½ inch in diameter. Smaller fruits add to the ornamental value and are bird food. Larger fruits cause a nuisance when dropping. Truly a remarkable small, flowering shade tree, particularly if yellow- or red-fruited. There is also available a very narrow upright form of the Siberian crab apple, dependable and tolerant as a standard or a flowering tree, high narrow hedge or screen.

The Dogwoods: Their potential value as ornamental trees has hardly been discovered for municipal and business-area landscaping. In home gardens we find the dogwoods either as part of the screen planting or as oversized treelike shrubs, branched close to the ground and taking up as much as several hundred square feet of garden space. The native dogwood, *Cornus florida* and the pink-flowering forms, readily respond to form-training in the nursery or at the planting location to become small standard trees. Spring bulbs, some perennials, ground covers and turf can then be established and maintained under them. Add to this a garden bench and you have a feature without equal when the tree is in bloom or in its autumn color.

Cornus florida, when trained to standard trees, makes a good choice for interplanting with larger trees along streets of suburban developments, and the same form is ideal for mall or walk planting where good growing conditions can be maintained. The dogwood enthusiasts will find some excellent new improved varieties with larger white flowers or deeper pink flowers, with double flowers and either reddish or varigated foliage. Keep these in mind when choosing dogwoods.

Cornus kousa, the Japanese dogwood, makes its own show about two weeks later and is excitingly beautiful. But this tree resists form-pruning and is best grown as a low-branched or half-standard tree. My efforts to shape this dogwood to standard form failed. Either they persisted in heavy suckering from the base or the top branches stunted. In fact the general growth of this dogwood is more typical of a large shrub.

The rare *Cornus controversa* must be

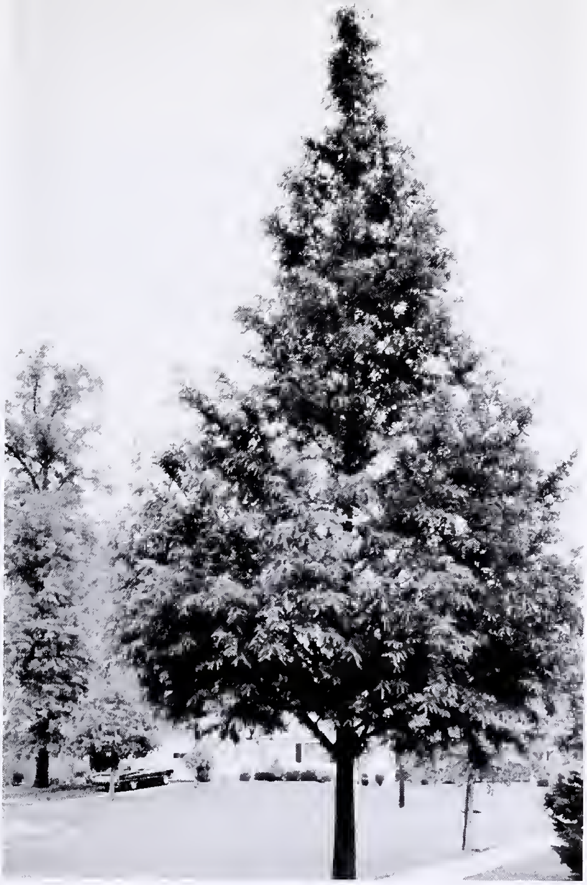
A 20-year-old specimen of the Callery pear *(Pyrus calleryana)* in Maplewood, New Jersey. It is close to its ultimate size and shows the characteristic opening of the crown. This tree is also recommended for home grounds where there is space for its 30-foot spread.
Sickles

mentioned. It is a medium-size tree, shaping up readily to a good formal branch structure. The flowers somewhat resemble those of "Queen Ann's Lace." It is not as showy as the others. We found it quickly in trouble when not regularly watered the first year after transplanting. To this I must add that the professional plantsman and the home gardener should be aware that all dogwoods are quickly discouraged by poor location, by competition with aggressive trees and particularly by neglect.

Dogwoods are shallow rooted, sensitive to overheating and compacting soil, low fertility or strong chemical fertilizers and easily injured by drought. We get best results by broadcasting Hollytone, a fertilizer high in cottonseed meal, under the trees in the fall, and adding 2 inches of old woodchips or leafmold as mulch. The fertilizer is calibrated at about 2 lbs. per one-inch trunk diameter. Borer infestations often follow exposure and drought. Creating the best growing conditions is far more effective than chemical control.

Flowering Cherries: Here it is more difficult to pick out the best for street, garden and mall planting. Generally the Kwanzan is first choice, being the most spectacular in flower, and also it is readily produced to standard form in the nursery. We prefer the single cherries, the Yoshino, the Higans and the Sargent. Durable, fairly deep rooted, compatible but requiring good soil conditions. Leaf rust, scale and borer insects must be watched. Yoshino and Sârgent cherry have a 30-35--foot spread; the Higgins cherry, 25-30 feet.

Hawthorns: Outstanding is the Lavalle hawthorn, a hybrid from France, and widely used in Europe as a street, small



The metasequoia or dawn-redwood is a conifer which loses its foliage in winter. Note the almost total lack of butt swelling of this tree due to the removal of lower branches up to about 7-9 feet on the trunk.

Sickles

garden and mall tree. It should do very well in large planters. Very adaptable to our climate; it is clean, deep-rooted, compatible, very tolerant and rarely troubled by pests and smog. It is drought resistant. Flowers, foliage and fruit are all very ornamental. It rarely exceeds 25 feet in height and spread with a trunk diameter of 10-12 inches. As it is easily shaped and long lived, it qualifies for the small garden, in business and municipal landscaping and as a street tree. Very few of our nurseries make the effort to grow the Lavalle hawthorn as a standard tree form, which it will readily do.

There are other hawthorns including some very promising new introductions.

Goldenrain Tree (Koelreuteria paniculata): If one looks for exotic features in a tree, then this one should satisfy. It has beautiful flowers in midsummer when color is scarce among trees. Very interesting are the Japanese-lantern-like seedpods appearing later, first light green and finally a glossy brown. Not too easily grown with a straight trunk as it takes more nursery and pruning at planting to shape a good crown 8-9 feet above ground level. A very deep-rooted, drought-resistant, compatible tree, but it should have good soil. It is a conversation piece in any garden and does very well with us as a flowering street tree.

There is a limit to any recommendations and the list is already lengthy with so many fine and promising trees, big and small, not mentioned, but we must not overlook the Turkish hazelnut tree, *Corylus colurna.* It is still a rare tree, but appears to be very well suited for the small-to-medium garden. It is a very handsome tree in summer and winter. ◆

Some shrubs are more prone to insect attack than others

SUGGESTIONS FOR INSECT-RESISTANT SHRUBS

Richard J. Gouger

SOME of the most attractive shrubs recommended for shade are unfortunately susceptible to insect invasions. Many pests fall into the nuisance category, but others can be serious enough to make the home owner avoid the plants they prey upon and where practical consider substitution of less susceptible subjects. However, rarely do all the pests associated with a plant or group of plants appear at once, and sometimes never, especially around home grounds. Therefore, even those plants which are hosts to many pests (see table which follows) can be grown successfully. As a safeguard, they can be sprayed two or three times a season with the recommended chemicals (always follow directions). It would be ideal if such plants as flowering dogwood, rhododendron and azalea—three of the most suitable as well as most beautiful of plants recommended for shaded gardens, but also host to several kinds of pests—had resistant counterparts equally as beautiful.

The following table has been prepared as an indication of susceptibility of the various shrubs commonly grown in shade to insect attack. The figures under relative susceptibility indicate the degree of immunity, plants having the higher numbers (3-4-5) being usually less susceptible to insect injury.

Diseases and other factors should also be considered in selection of shrubs for shady places. It is of interest that some of the insects listed, lace bugs for example, are rarely found in shade in large numbers so, while they can not be excluded, do not constitute an important consideration when selecting shrubs for shade. In fact, lace bugs, which can disfigure or seriously damage andromeda (*Pieris*) when it is grown in sunshine, virtually disappear when the same plant is moved into shaded or partially shaded locations.

Red chokeberry *(Aronia arbutifolia),* along with other species of the genus, rates high among shade-tolerant shrubs in near immunity to insect damage. It is native to the eastern United States, and is effective in flower in May and later when its red berries have formed.

Genereux

RELATIVE SUSCEPTIBILITY OF SHADE-TOLERANT SHRUBS TO INSECT PEST DAMAGE

(Shrubs having the higher numbers should be given preference by insect-conscious gardeners)

Host	Relative Susceptibility	Insects
Acanthopanax sieboldianus Fiveleaf Aralia	5	Four-lined Plant Bug
Amelanchier (Various) Shadblow	1	Wooly Elm Aphid Borers Oystershell Scale Pear-slug Sawfly
Aronia (Various) Chokeberry	5	Roundheaded Apple Tree Borer
Azalea	1	Azalea Stem Borer Rhododendron Borer Lace Bug Leaf Miner Mites Azalea Bark Scale Soft Azalea Scale Black Vine Weevil
Berberis thunbergii Japanese Barberry	3	Barberry Aphid Barberry Scale Barberry Webworm Japanese Weevil
Buxus (Various) Boxwood	2	Boxwood Leaf Miner Boxwood Mite Boxwood Psyllid
Ceanothus americanus Jersey-tea	4	Ceanothus Aphid Ceanothus Lace Bug San José Scale
Cephalanthus occidentalis Buttonbush	4	San José Scale
Cornus (Various) Dogwood	1	Borers Leafhoppers Dogwood Scale
Euonymus fortunei Wintercreeper	1	Green Peach Aphid Euonymus Scale
Forsythia (Various) Goldenbells	5	Four-lined Plant Bug
Hamamelis virginiana Witch-hazel	5	Saddle Prominent Caterpillar Witch-hazel Cone Gall
Hydrangea (Various)	3	Aphids Rose Chafer Hydrangea Leaf Tier Mites
Ilex crenata Japanese Holly	3	Leaf Miners Mites
Kalmia latifolia Mountain-laurel	2	Azalea Stem Borer Rhododendron Borer Lace Bugs

(*Continued*)

Relative Susceptibility of Shade-tolerant Shrubs *(Continued)*

Host	Relative Susceptibility	Insects
Ligustrum (Various) Privet	3	Lilac Borer Privet Thrips Greenhouse Whitefly
Lonicera morrowii Morrow Honeysuckle	2	Honeysuckle Aphid Long-tailed Mealybug Honeysuckle Sawfly Oystershell Scale San José Scale
Myrica pensylvanica Northern Bayberry	5	Red-humped Caterpillar
Pieris floribunda Mountain Andromeda	4	Japanese Lace Bug Florida Wax Scale Mites
Rhododendron (Various)	2	Azalea Stem Borer Rhododendron Borer Rhododendron Lace Bug Taxus Root Weevil
Rhus canadensis Fragrant Sumac	2	Sumac Aphid Currant Borer Sumac Psyllid Cottony Maple Scale San José Scale
Ribes alpinum Mountain Currant	1	Currant Aphid Currant Borer Imported Currant Worm Sawfly Flatheaded Apple Tree Borer Pacific Flatheaded Borer
Rubus odoratus Flowering Raspberry	1	Raspberry Aphid Borers Mites Strawberry Root Weevil Glacial Whitefly
Sambucus racemosa Red Elder	2	Aphids Elder Borer Currant Borer San José Scale
Symphoricarpos albus Snowberry	3	Aphids Snowberry Clearwing Moth San José Scale Glacial Whitefly
Viburnum (Various)	2	Aphids Dogwood Twig Borer Mites Scales (Various)

Buyers' Guide

SOURCES FOR PLANTS FOR SHADE

NO ONE NURSERY sells all plants which are suitable for every kind of shade that exists. Nor is it practical or possible here to list every nursery which offers plants for shade, but enterprising gardeners will find many in the catalogs below as well as from general nursery sources, which may be mail order or local.

Alpenglow Gardens, 13328 Trans-Canada Highway, North Surrey, British Columbia, Canada. Rare plants. (Catalog 25 cents.)

Gardens of the Blue Ridge, Ashford, McDowell County, North Carolina 28603. Hardy ferns and native plants.

Goodwill Garden, Route 1, Scarborough, Maine 04074. Hardy plants. (List 6¢ stamp.)

Gossett Gardens, 4118 Main St., Union Gap, Washington 98903. Varied plants, ground covers. (List 10 cents.)

J. Herbert Alexander, Middleboro, Mass. 02346. Ground covers.

Joel Spingarn, 1535 Forest Avenue, Baldwin, N.Y. 11510. Dwarf conifers. (Catalog 25 cents.)

Kathelen Gardens, Durham, New Hampshire 03824. Rare plants.

Leslie's Wild Flower Nursery, 30 Summer St., Methuen, Mass. 01844. Hardy ferns and wild flowers.

La Rocaille, 5 Forest Court, Larchmont, N.Y. 10538. Plants for the connoisseur.

Laura's Collectors Garden, 5136 South (Catalog 50 cents.) Raymond St., Seattle, Wash. 98118. Rare plants.

Mellinger's, North Lima, 2310 West South Range Rd., Ohio 44452. General.

Mincemoyers, Route 5, Box 379, Jackson, N.J. 08527. Wild flowers.

Mrs. Glen Fisher, 4392 W. 20th St. Road, Oshkosh, Wisconsin 54901. Hostas.

Oliver Nurseries, 1159 Bronson Road, Fairfield, Conn. 06430. Rhododendrons, azaleas, conifers.

Orchid Gardens, Grand Rapids, Minnesota 55744. Wild flowers.

P. De Jager and Sons, Inc. 188 Asbury Street, South Hamilton, Mass. 01982. Daffodils and other bulbs.

Rainier Mt. Alpine Gardens, 2007 So. 126th Seattle, Wash. 98168. Hardy plants.

Siskiyou Rare Plant Nursery, 522 Franquette St., Medford, Oregon 97501. (Catalog $1.)

Sky-Cleft Gardens, Camp St. Ext., Barre, Vermont 05641. Hardy plants.

Sky Hook Farm, Johnson, Vermont 05656. Primroses.

Warren Baldsiefen, Bellvale, N.Y. 10912. Rhododendrons and azaleas. (Catalog $1.)

Wayside Gardens, Mentor, Ohio 44060. Many hardy plants, bulbs, shrubs for shade. (Catalog $2.)

Walter Marx Gardens, Boring, Ore. 97009. Many hardy plants for shade.

White Flower Farm, Litchfield, Connecticut 06759. Many hardy plants and bulbs for shade. (Catalog $1.50.)

Wild Garden, The, 8243 NE 119th, Kirkland, Wash. 98033. Many rare plants, ferns. (Catalog $1.)

Three Laurels, Madison County, Marshall, North Carolina 28753. Ferns and wild flowers.

Thurman's Gardens, Route 2, Box 259, Spokane, Wash. 99207. Rare plants.

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59.	Ferns	$1.50
60.	Handbook on Conifers	$1.50
61.	Plants for the Shade	$1.50

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WINTER
1969-70

NEW SERIES
Vol. 25 No. 4

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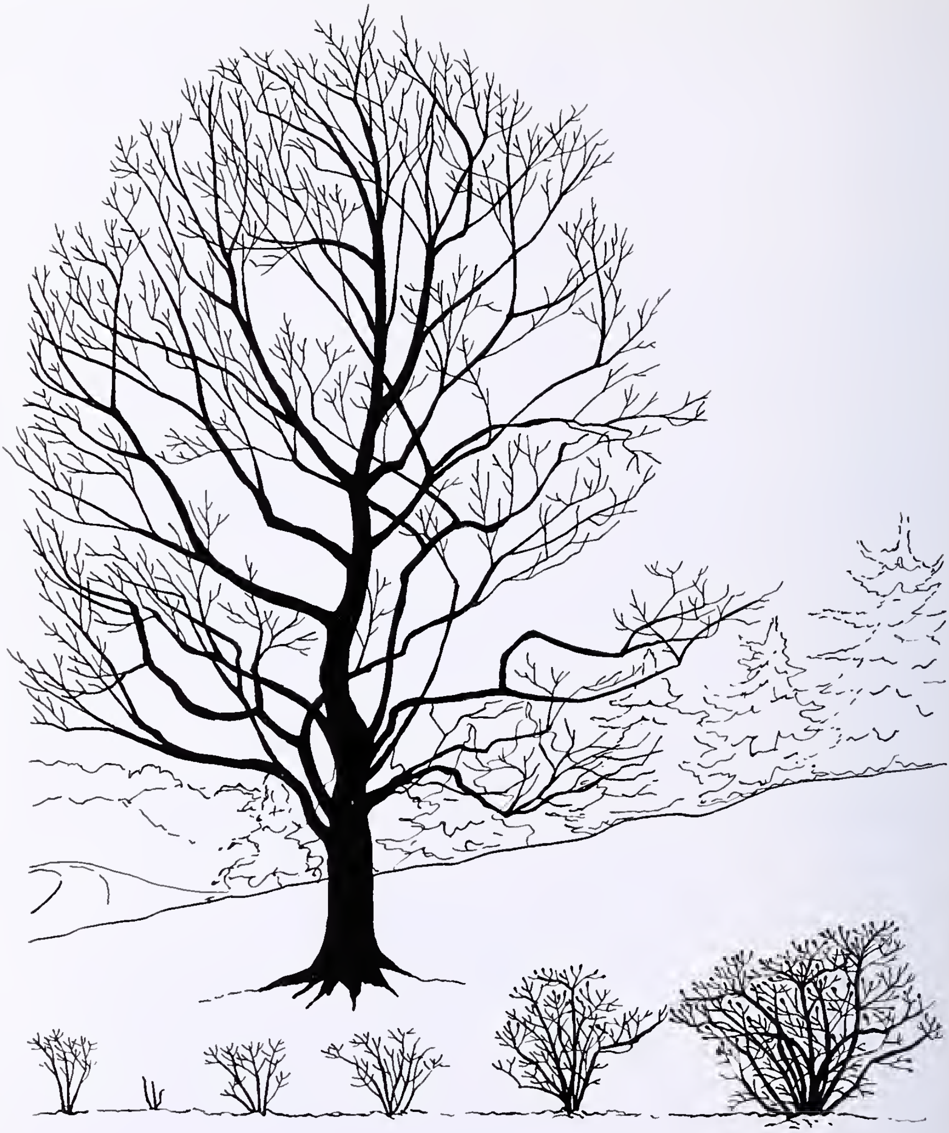
For a list of topics see back cover.**



Eva Melody

ENVIRONMENT—A *simple lesson concerning plants*—Quiet competition between tree and shrub. The root system of this huge 70-year-old hybrid oak gathers moisture and mineral nutrients from a large area, and its branches overhang and partially shade a 50-year-old row of star magnolias. At the left the nearest magnolia is 20 feet from the trunk of the oak; at the right, 60 feet. And at the right, the magnolia (5½ feet tall) receives full overhead light throughout the year, while leftward, each succeeding magnolia is increasingly shaded by the overhanging branches of the oak. Short spindly growth is the result. Thus, in competition with the oak for water and nutrients, the magnolias are at a great disadvantage—and with the added handicap of insufficient sunlight—they gradually lose out in the struggle for survival.

BROOKLYN BOTANIC GARDEN

The Year-end, 1969-70

This issue marks a quarter of a century of PLANTS & GARDENS. Contrary to a common practice, we have not made this a silver anniversary issue. The list (see back cover) of many of the Handbooks published over the years gives quiet testimony to what has been accomplished. And we shall continue to publish a year-end digest of current worthwhile horticultural literature—a practice which has always been favored by our friends and supporters. Sincere thanks to members of our Editorial Committee. It is only through their efforts and talents that this review issue is possible. We are particularly indebted to the authors, editors and publishers of the original articles. By sharing their findings, the authors afford all of us the opportunity of expanding our knowledge of the world of plants. It continues to be a privilege for the Brooklyn Botanic Garden to serve as the intermediary in bringing talented and informed authors and readers together to their mutual benefit.

What is in store for you as you pass beyond this page?

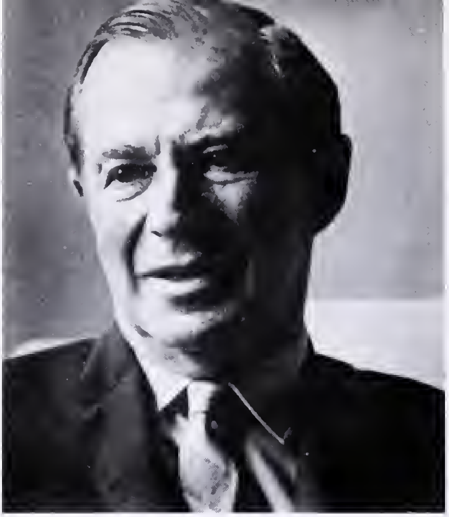
Today the "in" word is environment. It appears to be the key to much of our national thinking. Twenty-five years from now, we will know whether people here and the world over are fully awakened to the important implication of this word. You will find several features in this issue (see also facing page) which reflect the concern of scientists and informed laymen alike with the problems of environment. The articles speak for themselves. Members of our Editorial Committee feel that they present ideas and information for every dedicated gardener and horticulturist.

From its first issue, PLANTS & GARDENS has been the shadow or reflection of George S. Avery. His was the idea, his was the cultivation and care, his was the close attention to detail, the consistency of high standards and style, his was the wise choice of topics for special issues. From a four-figure number of circulation to a six-figure number, from readers in only a few states to readers in all fifty states and foreign countries, from mainly professional subscriptions to subscriptions from all manner of plantsmen—he has guided PLANTS & GARDENS happily on its way. Those of us who will succeed Dr. Avery during the next twenty-five years can only pledge to try to maintain the pace of quality he has established.

As the one now accepting the chief leadership responsibilities of the Botanic Garden, I can only say that given the same warm cooperation by all concerned with the work thus far, I will do everything I can to merit the friendly confidence that is the very heart of this challenging position.

Louis B. Martin

Director



A botanic garden "is important in enriching human lives"

Avery Got People Involved at the Botanic Garden

George F. Hull

Reprinted from The CHATTANOOGA TIMES, October 26, 1969

A BOTANIC GARDEN is plants and people. The people are those with the imagination to start it, the staff that operates it, the leadership that makes it useful and enjoyable in furthering man's understanding of nature.

This fall an outstanding institution, the Brooklyn Botanic Garden, will change its leadership. After 25 years as director, Dr. George S. Avery will retire. The new director will be Dr. Louis B. Martin, formerly director of the Denver (Colorado) Botanic garden. History of the Brooklyn garden reveals some of the factors that have made it great.

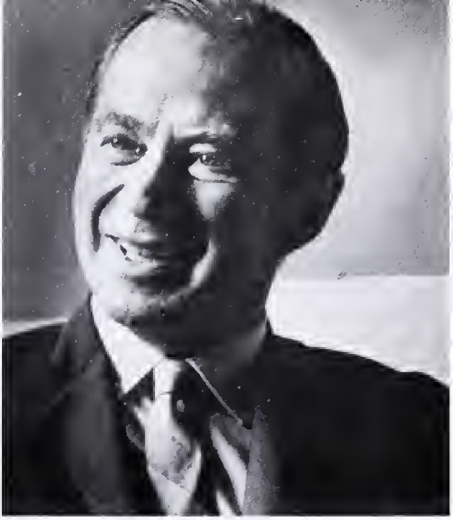
A botanic garden is imagination. There was the vision of the director of the Brooklyn Institute of Arts and Sciences in 1892 to see a botanic garden in a 50-acre tract, at that time largely an ash dump. Finally, 18 years later, through the generosity of an individual who also caught the vision, the reality began.

For 33 years the director was Dr. Charles Stuart Gager, a man who carried out an imaginative program to create "gardens within a garden," as well as to further scientific research.

In 1944 Dr. Avery became director. He found a good physical plant and staff, but during the war years, there was a lull in interest in such institutions. Among little noticed assets was an outstanding Japanese garden, but of such subtle beauty as to arouse little popular excitement. Another was a small collection of bonsai, Japanese miniature potted trees, still an unknown, shrouded in Oriental mystery.

Those who have visited Brooklyn Botanic Garden in spring, summer or fall, or during the winter, like my wife and me, find it a busy place, always filled with excitement.

There are plant collections and research



work to satisfy the expert. Most noticeable, however, is the involvement of people. Dr. Gager's idea of gardens within a garden has been developed and enhanced. Those knowing nothing of botany or horticulture are delighted by a walkway bowered with flowering cherry trees, a colorful rose garden, a fascinating garden for the blind, among the varied areas of development.

Involvement of people. How many parts eloquence, how many parts diplomacy have been used by Dr. Avery to involve people I do not know. But here I think is the essence of the greatness of the Brooklyn institution today. Trained as an academic botanist and scientist, Dr. Avery turned to the job of mixing plants and people, of firing the imagination of the staff and the public.

Children Helped

Thousands of children have learned gardening through doing, and literally millions more have been reached by a program of seed distribution in schools. For adults, study courses over several weeks, or one-day courses especially attractive to out-of-towners, have benefited thousands. Of more than 6,000 who take such courses each year, a fourth are from beyond the city, some traveling a thousand miles to attend.

Perhaps the most obvious special feature Dr. Avery has brought to the garden has been the opportunity for the American public to increase its understanding of the Japanese reverence for nature. The bonsai collection has become the outstanding one in this country. Japanese experts have been brought here on fellowships to train the plants and to offer courses in instruction. Gifts have added valuable plants to the collection. When this program got under way less than 20 years ago, the art of bonsai was largely unknown in this country, except to a few Japanese-Americans on the West Coast. Today, this new kind of "little trees" that grow in Brooklyn has provided the seed-idea which has spread throughout the country with scores of individuals and clubs studying the art.

The old Japanese garden has been improved by skilled maintenance. And a few years ago a replica was built of the famed stone garden of the Ryoanji temple in Japan. This is an abstract design of rocks and gravel with just a small amount of moss at the base of island-like stones.

Eloquence that has reached a wide audience is the quarterly publication PLANTS & GARDENS started by Dr. Avery in 1945. An idea for the format has made this especially useful. A guest editor, an expert in his field, is selected for most issues, and this editor in turn enlists the help of other authorities. A single subject usually is covered. Thus each issue is an up-to-date, complete presentation of the theme, suitable for reference. Subjects have ranged from weeds to ferns.

Popularity of some issues—such as the two numbers devoted to bonsai—have required fifteen or more reprintings to supply the demand.

Meaningful involvement of people can mean support. A little less than half of the cost of operation is supplied by the City of New York. The rest has come from gifts, bequests and endowment. Money from the City goes for maintenance and the staff. Gifts have gone to new functions, research and special features. One might say that gifts by supporters of the Garden have provided the frosting on the cake. But what gifts have made possible is much more important. They have brought broader and deeper meaning to the institution, with the innovations and improvements they have made possible.

The Brooklyn Botanic Garden is a unique "garden of gardens" in an area of concentrated population. One out of every 20 Americans lives within 20 miles of it! The need of those nearby is great, but the influence of the Garden spreads far. One and one-half million persons visit it each year, as many as 30,000 a day in some seasons. Membership in the Garden and its publications is to be found in all fifty states, and as many countries.

A successful record so far for the Brooklyn Botanic Garden suggests a bright future under Dr. Martin's stewardship. Perhaps one of the challenges will be to improve the physical plant by constructing new greenhouses and buildings that will make possible more all-weather use of facilities. Adjustment to modern transportation and the needs of an even greater population should increase the value of this oasis in a city, where man can renew his contact with nature. ◆

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*Provide correct conditions for alpine plants**

Notes on Scree Building

Gerhard Sidow

Reprinted from American Rock Garden Society BULLETIN, Jan. 1969

THERE must be many rock gardeners who would like to try their green thumb by growing the more demanding alpine plants, but feel that their local climate, or the location of their garden, forbids any thought of successful scree gardening. Faced with such difficulties, I was, nevertheless, determined to have my scree and to overcome the difficulties as best I could. Having come to the conclusion that I have had some success, I feel that it would be worth while to pass my experience on to those who face similar problems.

My rock garden was built upon an embankment of between 35 to 40 degrees, facing east-southeast, with its top soil being poor. The climate of Montvale, New Jersey, closely resembles that of New York City; Montvale being about fifteen miles northwest of that city. Temperature and humidity are high in summer and the winters are temperamental, with temperature fluctuations of forty degrees within twenty-four hours not uncommon.

Would saxifrages thrive on a steep hill facing the hot sun for the greater part of the day in this climate? They might prefer better conditions but they will grow and bloom for you under these conditions if you give them some of your time.

My scree was built from the very foot of the hill, running about seven feet up with an average width of about five feet. A hole was dug into the hill at the foot of the embankment to a depth of one foot and extended upward to about two feet at the top, exposing the hard subsoil. The mixture of the soil to be filled into the cavity thus created differs considerably from recommended scree mixtures, since such a porous mixture would not be able to retain enough moisture on such a steep grade. Since drainage on a hill is no problem, but drying out definitely is, I made the mixture much more compact and water retaining than is usually used on more level ground. I used five parts garden loam (pH 7-8), one part sand, one part lime chips, and some partially decayed leafmold (maple and sycamore).

Before filling the cavity with this mixture, I put two metal pipes at the top of the hole straight down to the bottom, so that after the cavity had been filled up to the surrounding level with the scree mixture, the two pipes would protrude 2 inches above the ground. The scree mixture was then filled in—with some rocks used to break the surface of the scree. The extending pipes were camouflaged by plants and rocks. Next, three large clay flower pots were buried to the rim also at the top of the scree, care being taken that they might not be easily seen. The whole surface of the scree was then covered with small stones and pebbles of a texture to blend in with the rocks used throughout the garden.

It was hoped that the water poured into the pipes would run downhill underneath the scree and that some of it would return to the surface by capillary attraction, giving the roots needed moisture, and, by evaporation, reduce the heat of summer by a few degrees. The flower pots serve the same purpose for the plants closer to the top of the hill.

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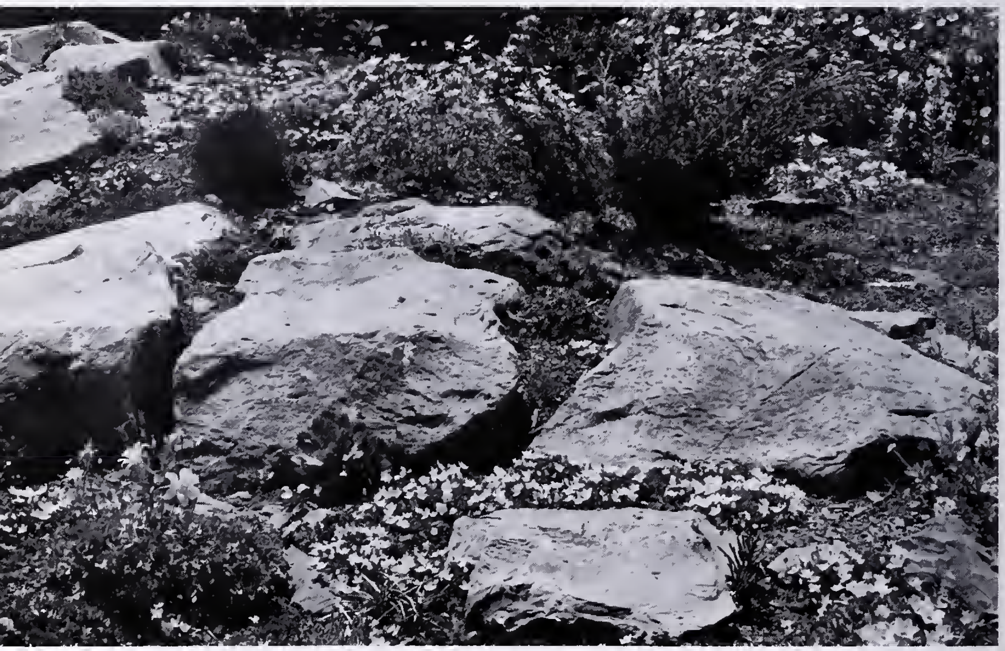
*Alpine plant enthusiasts will discover interesting new facts about growing alpine plants in containers—as the Japanese do it. See Tomoya Funahashi's "Raising Wild Alpine Plants in a Home Garden." PLANTS & GARDENS, Winter Issue 1960-61, pp. 30-35. A few copies of this back issue are available from the Secretary of Publications, Brooklyn Botanic Garden, $1.00 postpaid.

In the spring of 1966 the project was completed and some plants were set out. Every rainless morning during the summer months, the pipes and pots were filled with water and though the summer of 1966 was exceptionally hot and dry, drabas grew into tight little green balls, *Androsace sarmentosa chumbyii* spread its silver rosettes all over the pebbles, various *Saxifraga aizoon* plants looked healthy all through the summer, and *S. burseriana* held its own and a little better. *S. decipiens* browned out to about 50 percent during the summer, but recovered splendidly in the fall. *S. stribrnyi* did not make it, but little *Dianthus carthuria nana* (?) bloomed nicely that first summer. The scree is further populated with *Dianthus alpinus, D. neglectus, Erigeron compositus,* and *E. pinnatisectus.* The second year all plants performed well and bloomed as expected.

The scree is exposed to the full force of the sun up to noon when a distant maple casts a light shadow. The strength of the afternoon sun is blunted by the tilt toward the east of the scree. Surely none of the plants mentioned are the most demanding, but few would have survived, or much less flourished, without the preparations. More difficult ones will now be tried, but even if they should not succeed, the huge flowers of the tiny *Saxifraga burseriana* in March is reward enough for my labors. ♦

BUILDING A SCREE

A demonstration by George Schenk at his nursery, The Wild Garden, in Seattle, Washington



A scree at The Wild Garden. In nature screes are at the base of cliffs or on mountain ridges, and are filled with deep layers of stone flakes or fragments. In foreground above are *Aquilegia scopulorum, Talinum okanoganense, Oxalis adenophylla.*

Excavating area for scree. A bed 18 inches deep is dug about deep, exposed "faces" of rocks in imitation of nature.

After filling excavation with 3-inch layer of ½-inch gravel and builders sand, mix them with the soil.

After thorough mixing of 3 ingredients (soil must not be wet), "jog" in scree to settle entire mixture for planting.

Blue-gray crushed stone, which is color of large stone grouping, is added to scree surface in 1-inch layer.

Dwarf evergreens (*Juniperus communis* 'Compressa') are put in place first.

Lane Publishing Co. and Don Normark

High alpine "small fry," such as these Kabschia saxifrages, are planted last.

Dwarf forms of a favorite conifer

New Forms of the Common Hemlock

Joel Spingarn

Reprinted from the American Rock Garden Society BULLETIN, August 1969

IN THE YEAR 1933, Charles F. Jenkins of Germantown, Pa., enamoured with the genus *Tsuga*, decided to disseminate information and create interest in this conifer and its variants by publishing a modest periodical entitled *The Hemlock Arboretum Bulletin.* Mr. Jenkins had established a comprehensive collection of hemlock variants and many notable horticulturists visited his arboretum. Many of the visitors added to the collection and during the fifteen years or so that Mr. Jenkins was active, the arboretum grew and much information relating to the genus *Tsuga* was published in the *Bulletin.*

The beginnings of a noteworthy event occurred when Mr. Jenkins, in *Bulletin* No. 19, dated July 1, 1937, laid down a challenge to his readers by suggesting that a college graduate in the field of botany, horticulture, biology, ecology, dendrology, landscape gardening, or some kindred science, work on a thesis in preparation for his doctor's degree; the topic to be "Mutations of *Tsuga canadensis.*" The challenge was taken up by John C. Swartley, who was enrolled at Cornell University for advanced study in ornamental horticulture. Dr. Swartley had been connected with the Morris Arboretum for about five years and had done some preliminary work sorting and relabeling some misnamed *Tsuga* forms at the Hemlock Arboretum. He was undoubtedly well qualified for the job as the resulting thesis, entitled "Canadian Hemlock and its Variants," became the standard reference, and to my knowledge is the only comprehensive work done on the genus *Tsuga* in almost thirty years. Unfortunately, Mr. Swartley's thesis has never been published and it is presently not easily available.* I was able to borrow a copy from Cornell University through my local library.

Since 1939, the year the hemlock thesis was completed, many new forms of *Tsuga* have appeared, many of these being only duplicate variants of forms already mentioned by Dr. Swartley, but occasionally a distinctly different form or a much improved duplicate variant appeared under the watchful eyes of collectors. In a number of cases these have been sorted out, propagated and distributed to arboretums, botanical gardens, and private collectors. The following are a few forms of *Tsuga*, with brief descriptions, that I have encountered in my travels and, in most cases, added to my collection.

Tsuga canadensis 'Armistice'—My plant was obtained in 1959 from a nurseryman in Concord, Mass., under the name of 'Warner's Armistice.' It was then 15" across. It now averages 20 inches high and 30 inches across in 28 years. In outline, it is a flat-topped globe with horizontally tiered branches and dark green, very compact shining leaves. Although this "name" has been published before, I mention it again because my plant appears to be a different form than the specimen in the Gotelli collection at the U.S. National Arboretum.

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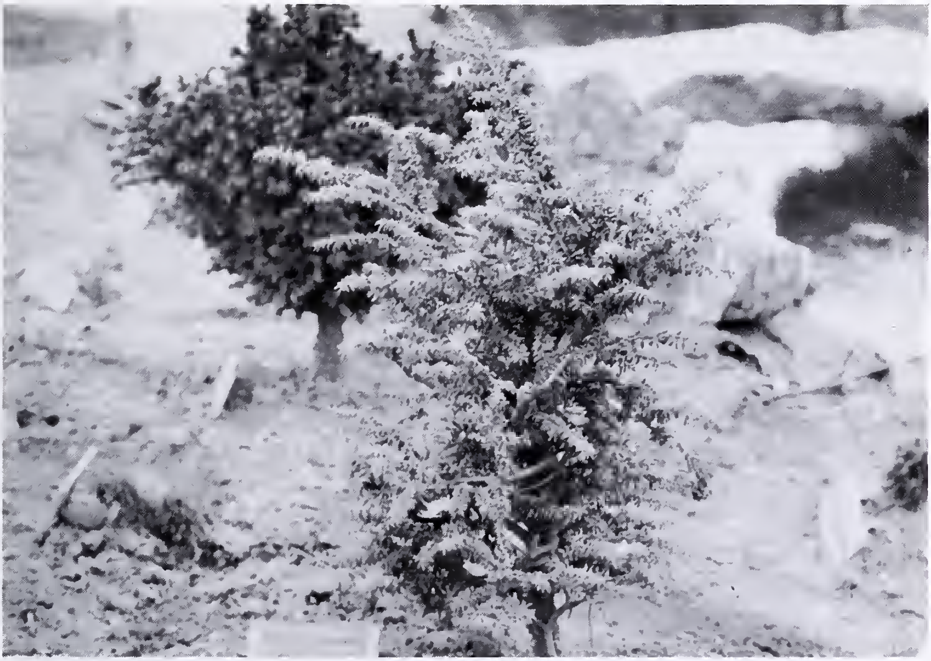
*Dr. Swartley is currently bringing together all of the known available information on hemlock varieties and cultivars, new and old, for publication in 1972. Dr. Swartley invites communications on newer varieties. His address: E. Tennis Avenue, Ambler, Pa. 19002.



Tsuga canadensis 'Verkade Recurva'—12 inches wide, 16 inches high, 15 years old.

The Gotelli plant is pyramidal in outline and although a fine form, is not distinct from many other existing hemlock variants. The plant in my collection, 'Armistice' or not, is one of the handsomest forms of *Tsuga* I have.

Tsuga canadensis 'Aurea Compacta'—This plant, in color, is similar to 'Aurea' (or more correctly, 'Everett's Golden'). It probably originated by propagating the weaker growing side branchlets of this form. It is extremely slow-growing, rarely making more than an inch in one season. It is somewhat irregular in outline; younger plants attaining little height and mostly growing outward. An old plant may be a foot across, very compact, and fifteen or more years old. Some plants eventually throw up a leader and will probably become squat pyramids in outline.

Tsuga canadensis—Sport of 'Cole's Prostrate'—Some doubt exists that this form was raised from a mutant branch of 'Cole's Prostrate' but there is little doubt that the plant in my possession is a gem. The plant was one of three purchased from a nurseryman as a rooted cutting of 'Cole's Prostrate.' After a few years it became a very diminutive globose bush, somewhat resembling the form 'Horsford.' I questioned the nurseryman at a later date as to the possibility of mislabeling, but he insisted he had never propagated from 'Horsford.' My plant is now 12 years old and 13" through and 6" high.

Tsuga canadensis 'Curly'—This plant was brought into cultivation by Mr. Harold Epstein. While visiting a friend, Mr. Epstein found a distinct seedling with sickle-shaped leaves growing in his garden. Mr. Epstein took a few cuttings and raised some plants. The whereabouts of the parent plant is now unknown and its owner deceased. My plant, now six years old, is of irregular outline, 12 inches high and 15 inches across.

Tsuga canadensis—Dwarf upright form—This plant grows upward very slowly. It is almost fastigiate in outline and

Hemlock cultivar 'Armistice'—28 years old, 30 inches across, 20 inches high.

quite distinct. My plants, 24" high and 11" in width, are nine years old. They were purchased from a nurseryman in Aurora, Oregon, who has since changed the name to *Tsuga canadensis* 'Lewis.' I obtained a plant of the latter from Mr. Carl Starker in 1960. He wrote that his plant originally was obtained from an ardent plantsman, Mr. Clarence McKay Lewis of New York. To add to the confusion, the true plant of *T. can.* 'Lewisii' appears to be different from the form, *T. can.* 'Dwarf Upright', not being fastigiate in outline.

Tsuga canadensis 'Greenspray'—We are indebted to Mr. Henry Hohman for introducing this fine hemlock. The placement of leaves presents a texture that immediately distinguishes it from forms of similar habit. It is moderately rapid in growth, forming arching sprays all around the plant. My plant, obtained five years ago, is probably eight or nine years old and measures 20 inches high and 3 feet across.

Tsuga canadensis—Sport of 'Jervis'—I have been unable to find any differences between this plant and the regular form of 'Jervis.' It is supposedly of more rapid growth, but my plant, now between twelve and fourteen years old, is 16 inches high and 13 inches across. The plant grows as rapidly, or nearly so, as the form *T. can.* 'Pendula' from which it was probably derived as a seedling. The primary difference between the two is that apparently the form *T. can.* 'Minuta Pendula' is much lower growing and spreading. In my opinion, the varietal epithet "minuta pendula" as published in the Brooklyn Botanic Garden Handbook *Dwarf Conifers,* Vol. 21, No. 1, was poorly chosen as it is misleading, the plant hardly being "minute." My parent plant was raised by Mr. Carl Starker. Mr. Starker wrote me in 1960 describing the plant to be 18" tall and 3' across. At the time the plant was unnamed. Since its distribution it has acquired three additional varietal names; 'Starker's Pendula,' 'West Coast Creeper,' and 'West Coast Spreader.' Conifer buffs are aware that Sargent hemlock (*Tsuga canadensis* 'Pendula') comes true from seed and the seedling population shows varied degrees of genetic dwarfness and pendulous habit. My collection includes two specimens grown from seed of the Sargent hemlock (*T. canadensis* 'Pendula') that grow less than half the rate of the parent.

Tsuga canadensis 'Palomino'—This plant forms a very dwarf compact globose bushlet. The leaves are small and branches and branchlets very thin and flexible. The buds are hairy and resemble the buds of form *T. canadensis* 'Cinnamonea.' It may well be an improved and dwarfer duplicate variant of that form. The parent plant is owned by Paul Palomino of Long Island. It is now 21 years old and measures 13 inches high and 21 inches across.

Tsuga canadensis 'Pygmaea'—One of the most sought after and rarest of the hemlock gems. It forms a sub-globose miniature bushlet of exceedingly dense foliage, resembling the form 'Minuta.' The plant growing in my collection measures 6½ inches wide by 4 inches high, and is ten years old. I raised the plant from a single cutting generously supplied by William Gotelli. I have attempted to trace the origin of this form. Mr. Gotelli's plant was obtained from Henry Hohman of Kingsville Nursery, who raised the plant from a single scion supplied by Joseph Gable of Stewartstown, Pa., in 1941. I have been unable to contact Mr. Gable, so there the search ends. However, John C. Swartley wrote that the form 'Pygmaea' is similar to 'Minuta,' the latter having slightly longer leaves. His inference, I believe, is that the form 'Pygmaea' is one of the seedlings of 'Minuta' collected at the site of the parent plant discovered in Charlotte, Vermont. Dr. Swartley also suggests that the growth rates are apparently the same, and I suppose this would be correct if one were to consider that the difference in growth rate is only a fraction of an inch. However, upon actually taking measurements, I found the form 'Minuta' grows ⅜ inch on the shortest shoot and up to ¾ inch on the longest shoots, while 'Pygmaea' measures ⅛ inch on the shortest shoots to ⅜ inch on the longest shoots. So, relatively speaking, if we were to strike an average, the form 'Minuta' grows at twice the rate of 'Pygmaea'! Both plants measured are well established and growing on the same site.

Tsuga canadensis—Dwarf pyramid form —A collected seedling about 15 to 18 years old, the average growth being one inch annually. It forms a squat pyramid of very dense, soft-textured foliage, 20 inches across and 14 inches high. It is best sited in partial shade and becomes an exceedingly handsome pygmy conifer.

Tsuga canadensis 'Variegata Gentsch'—Viewed from a distance, this form appears to be a pure white globose bush, its variegation being very intense in the fall. It is moderate in growth, a twelve-year-old plant attaining 18 inches in height and 3 feet across. It was discovered by a nurseryman, Otto Gentsch of Long Island, growing among his small hemlocks. Mr. Gentsch does not know whether this plant originated as a seedling or a mutated cutting as he used both methods of propagating.

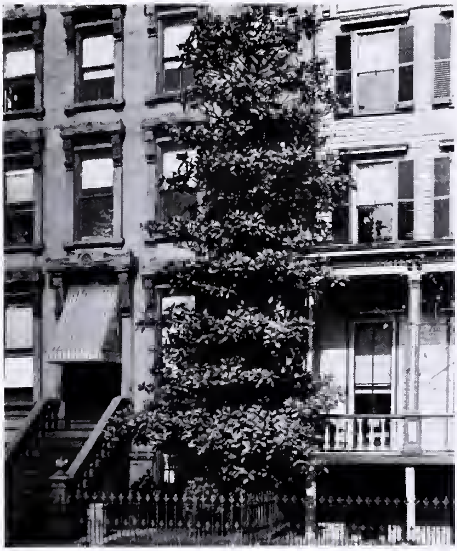
Tsuga canadensis 'Verkade Witches'-broom'—A very distinct form derived from a witches'-broom by Verkade Nursery in Wayne, N.J. It somewhat resembles the form 'Bennett' but in a miniaturized version. The plant is horizontally tiered, flat-topped, and very symmetrical. It requires a somewhat shaded site. The average annual growth of an older plant is 2½ inches. Younger plants start slowly. An eight-year-old plant is 6 inches high and 15 inches across.

The following three distinct forms were found by my good friend, John Verkade of Wayne, N.J., and have been registered with the Arnold Arboretum. The descriptions were supplied by Mr. Verkade:

Tsuga canadensis 'Verkade's Petite'—This little gem was found as a seedling. It has an average annual growth of 1/16 to ⅛ inch. It has a cluster of tiny brown eyelets on each of its tiny branches and in the spring it is a mass of light green when the new growth takes place. 'Petite' must be planted in the shade as it cannot adjust to the summer sun, but it is very hardy and will not be harmed in minus ten degrees. The parent plant is now sixteen years old, 2 inches high and 3½ inches across, and is an irregular globe.

Tsuga canadensis 'Jacqueline Verkade'—This plant was found in our seedling beds and is also planted at Pompton Lakes, N.J. It has an average growth of one-half to three-quarters of an inch per year. It has a perfect conical form and is very dense with dark green foliage throughout the year. This plant is now 5½ inches tall and 6 inches wide at the base. It is estimated to be ten years old. It will grow in full sunlight and will not burn in summer or winter.

Tsuga canadensis 'Verkade Recurva'—This form has a very irregular growth habit with an average growth of about 2-3 inches per year. The exotic parent plant is estimated to be 15 years old and is 16 inches tall, 12 inches wide at the base and is of pyramidal habit. It was found in a hemlock collector's nursery and given to us as a misformed plant that did not want to grow even after extra feeding. ◆



Louis Buhle

The magnolia in October 1923. *Below:* The tree in January 1970 with some friends—pupils of P. S. 228, Bedford-Stuyvesant.

World Wide Photos

A Southern Magnolia in the North

COAST-TO-COAST TV, radio and newspapers have dramatized the possible fate of this now-famous tree. At 85 years of age it is probably the largest of its kind (*Magnolia grandiflora*) north of Baltimore or Philadelphia. It grows in a protected spot by a century-old brownstone home on Lafayette Avenue, Brooklyn. But there is a problem.

Most of the houses in the block in which it lives have been demolished to make way for a new housing project. Architects advocate demolishing houses adjacent to the tree and building a high concrete wall to protect it from killing north winds. The soil area for the tree's roots would be about as now—it is like growing a 4-story-high tree in a large flower pot. Any disturbance whatever might kill!

The Bedford-Stuyvesant Beautification Committee under the inspired leadership of Mrs. Hattie Carthan wants to make certain that this remarkable tree lives on. There have been two hearings before the New York City Landmarks Preservation Commission seeking to have the tree designated an Historic Landmark, which could save the tree.

Mrs. Carthan's thousands of supporters, school children and adults, want to save the two immediately adjacent houses and reconstruct their interiors to serve as a children's museum. This, in turn, would leave the tree undisturbed; there would be no risk to its life.

The tree and the brownstones have become virtually spiritual symbols around which thousands of people in the community are rallying to save a bit of the past to revere and to hold in trust for the future.—*G.S.A.* ◆

Cold Hardiness in Woody Plants

C. J. Weiser

Adapted from a talk given at the 24th American Horticultural Congress,
Philadelphia, Sept. 16-20, 1969.

LOW temperature is one of the most important environmental factors that limits the growth of plants, and low winter temperatures restrict the regions in which many plants can be grown, or even survive. In horticulture, damage from freezing is an ever present threat, even in sub-tropical climates (citrus in Florida). Attempts to avoid winter injury seem now to be largely limited to altering the weather, breeding new varieties, or providing mechanical protection. Contemporary studies point to means for bettering the chances of winter survival of semi-hardy plants by a) inducing dormancy a little earlier in the autumn and b) by prolonging dormancy (the winter rest period) by a week or two in the spring. It may also be possible to increase mid-winter hardiness to some extent. To successfully achieve these goals we must know more about how plants adjust to different freezing limits.

When woody plants are actively growing, death occurs at the moment they freeze, usually between 25° and 30° F. After dormant plants have acclimated during the autumn and early winter, they still freeze at 25° to 30° but death no longer occurs at the moment of freezing. This is apparent in many trees and shrubs in which the hardy stems exhibit several freezing points between +30° and —30° but withstand immersion in liquid nitrogen at —320° if cooling is relatively slow down to —30°. If cooling is too rapid, however, even very hardy plants are killed at temperatures slightly below freezing. For example, evergreen foliage hardy to —125° was killed at +17° when the foliage temperature dropped about 13° in one minute. Temperature changes of this magnitude have been observed in nature when plants are suddenly shaded on sunny winter days. Sunscald on tree trunks and winterburn on evergreens are probably due to these rapid temperature changes which are thought to cause lethal ice crystallization inside the living cells.

In contrast to bark and evergreen foliage tissues, flower buds appear to be killed at the moment they freeze at all times of the year, but the freezing point changes with the seasons. Some flower buds can very effectively avoid freezing in the winter. In Minnesota dormant deciduous azalea florets have been observed to avoid freezing to temperatures as low as —45°.

The acclimation process often consists of two distinct stages in hardy deciduous trees and shrubs. The first stage is apparently induced by the shorter days of autumn and the second by frost. Short days stop growth by inducing dormancy and they also initiate the first stage of acclimation by inducing the synthesis of a translocatable hardiness promoting factor (a hormone) in the leaves. Plants have biological clocks which measure the shortening daylengths in the autumn and set into motion the metabolic machinery responsible for adaptive responses such as cold acclimation.

The biological clocks of adapted species are synchronized with the climatic characteristics of the environment in which they have evolved. For this reason it is a good idea to pay close attention to the source of nursery stock. Studies of the cold hardiness patterns in red-osier dogwood (*Cornus stolonifera*), for example, have revealed major differences in the rate and timing of hardiness among various climatic races of this species. When grown in Minnesota, over 25 clones of this species collected from all over North America became hardy to —320° by mid-winter, but the acclimation patterns were very different. Coastal clones were often severely injured by early fall frosts. A clone from Dickinson, N. D., for example, began cold acclimating 8 weeks earlier in the autumn than a clone from Seattle, Washington when they were grown in Minnesota. The Dickinson clone was hardy to —13° by September 15th while the Seattle clone did not reach this level until 32 days later.

Considerable research is being done to find means of resetting the biological clocks of plants which are inherently hardy but lack the proper timing of acclimation to survive in a given environment. A good experimental example of this situation is flowering dogwood which, if properly acclimated, becomes hardy to —60°, but does not survive in mild climates when not acclimated. Eventual understanding of the now mysterious hardiness-promoting substance, which is produced in leaves under short day conditions, will ultimately enable us to regulate hardiness in plants.

This subject has had little study, but it is known that roots do harden as winter approaches. In red-osier dogwood for example, roots in winter will withstand a temperature of —4°, which is considerably less than the stems above the ground will tolerate. Stems below ground harden no more than roots, whereas exposed roots are capable of hardening as much as above ground stems.

The temperature that roots are exposed to during the autumn does not appear to influence hardiness of stems above ground. ◆

Dwarfing Trees in Japan—100 Years Ago

Reprinted from THE HORTICULTURIST AND JOURNAL OF RURAL ART AND RURAL TASTE, August 1870

A FOREIGN CORRESPONDENT of the *Boston Traveler* relates with how much curiosity he witnessed some remarkably successful specimens of dwarf trees in Japan.

I have seen in the gardens, more especially those about Owari, a maple, a pine, a peach and a camphor tree, all more than fifteen years old, with their limbs, leaves and trunks as perfect as any in a forest, and all grew from a box not a foot square, and not one was over two feet high. The trunks looked like old trees, and the limbs were gnarled and rugged as the mountain tree of the same kind. The owner told me that these trees would grow no larger for fifty years. In one garden there was a complete fruit orchard in a box four feet long and two feet wide. Pears, peaches, plums, apples, oranges, lemons, olives, bananas, and cherries, represented by perfect trees, the tallest of which was not over three feet. Whether these ever bear fruit I failed to ascertain; neither could I learn the process by which the tree is kept so small. But I am satisfied that it is done by killing a large tree and keeping a sprig, which starts from the old root for the dwarf. The climate and soil favor this torturing process, for a root will not die as long as it remains undisturbed in some localities. I saw great trees near the gateway of a temple yard at Sinara, which were bent over making a large circle like the curls in the pipe of a bugle. It must have been bent around something, fifty years ago. At another place a large oak tree was bored out from the joint of two limbs near the top to the roots, and a magnolia tree set out down in this hollow, which grew up inside the oak until it spread out its branches in the top, making of it an "oak magnolia." This tree has been spoken of by Japanese writers in native newspapers as an oak with a magnolia graft upon it. The system of grafting is carried to great perfection, and if they would introduce a larger variety of fruit trees they would find it very profitable.

"The problem of environment goes far beyond mere pollution."

Ecology and Problems beyond Pollution

Lee Berton

Reprinted from The WALL STREET JOURNAL, December 2, 1969.

"U. S. CITIES are mining the productive soils of the prairies and dumping useful nutrients into places like New York Harbor, where they are harmful, and the Hackensack Meadows in New Jersey, where they are useless."

That, says University of Pennsylvania Professor Ian McHarg, is perhaps the most pressing environmental problem uncovered in a just-completed five-year aerial and ground-level inventory of natural resources in the Delaware River Basin. Mr. McHarg is chairman of the Department of Landscape Architecture and Regional Planning at Penn, and the survey taken under his direction is one of the most extensive projects yet in the fledgling science of ecology, on the study of man's relationship with his total environment.

The problem of environment, ecologists stress, goes far beyond merely pollution, for all its current popularity in headlines and on television screens. For too long, they contend, man has thought merely of disposing of wastes, preferably in some innocuous way. But, Mr. McHarg declares, "burning garbage at incineration plants or burying it in landfill is stupid and senseless. All we get for our troubles are poisonous methane gas and poor foundations."

The real solution to waste management, the ecologists say, is to use sewage and other effluents wisely, so they benefit rather than damage the environment. By and large, wastes are fertilizers and foods needed by some organisms. Put in the right place they can be useful, but put in the wrong place they entirely upset the balance of the environment.

Sewage Disposal Difficulties

The problem is particularly obvious, and particularly pressing, in the treatment and disposal of sewage. Current treatment depends heavily on aeration to kill harmful bacteria and remove offensive odors. The resulting effluent is released into lakes and streams.

The process breaks sewage down into its constituent compounds of phosphorous, nitrogen and the like. These compounds are food for many organisms, and releasing too much of them into waters stimulates a clogging overgrowth. The much publicized "pollution" of Lake Erie, for example, does not actually result from inherently noxious chemicals. Rather it comes from an overabundance of generally beneficial ones, stimulating an excessive plant growth that uses up so much of the available oxygen fish can no longer survive.

John Cantlon, former president of the Ecological Society of America, says "We've got to plan our cities and rural areas so that waste management is one of the major elements, and we put in enough green space or swamp land to absorb our effluents through enrichment of the soil rather than pollution of our lakes and streams."

Ecologists generally support that opinion strongly. The principle is clear enough. Rather than run phosphates from sewage plants into Lake Erie, for example, spray them on green belts or forests surrounding cities, where more plant growth is needed. In working out the details, though, many projects remain only in the idea stage, and others serve mostly to suggest the difficulties and expense involved.

George M. Woodwell, a senior ecologist at Brookhaven National Laboratories in Upton, N. Y., suggests building small marshes and ponds as "great sinks for these nutrients." In these water bodies, Mr. Woodwell would harvest carp and rice, which he describes as excellent crops for absorbing sewage plant effluent. He has asked the Atomic Energy Commission for a grant of several million dollars to conduct a 10-year study of these "terrestial and aquatic swamps," which he describes as similar to Southeast Asia's "paddy-and-fish" irrigation systems.

Harvesting Aquatic Weeds

At Lake Mendota near Madison, Wis., University of Wisconsin researchers have been removing aquatic plants with special harvesting equipment for the past three years. "Before the city of Madison stopped spewing its sewage into the lake three years ago, the waters became so thick with milfoil, a spruce-like underwater growth, that boats and canoes couldn't sail and fish and humans couldn't swim," recalls Arthur Hasler, director of the university's Laboratory of Limnology (the study of fresh inland waterways).

Professor Hasler says these aquatic plants are being cut up after harvesting and are being used for hog feed and compost. "But we are removing the plants choking up Mendota with only three machines, which is like using one lawnmower on all our city parks," he says, "We need at least 10 of these weed harvesters or we're simply making a gesture rather than a real effort." The harvesters, however, cost $40,000 each and the city of Madison and surrounding Dane County can't afford more than three.

Michigan State University in East Lansing began a project two years ago to absorb the sewage effluent from its 40,000 students without polluting nearby lakes. Researchers at the university's Institute of Water Research,* discovered that if they constructed a system of connected ponds and small plots of woods and specific crops, they could absorb the nutrients in the effluent without upsetting the ecological balance of the landscape.

Marvin E. Stephenson, an associate professor working on the project, says five ponds and 200 acres of three-to-five acre plots of hardwoods or corn and alfalfa cover 450 acres. Pollution of the ponds decreases as each is drained into another and the final pond, which is five times the size of the other four, is clean enough for swimming. The first few ponds, which get the brunt of the sewage, are occasionally harvested of overgrowths of water weeds and plants.

Nutrients from the smaller ponds are used to fertilize small plots of land and each plot is being studied to see which plants or vegetables absorb phosphates or nitrates quickest. The budget for the project is $1.4 million.

At present the project is infeasible for large cities. Professor Stephenson estimates that 350 square miles of ponds and plots would be needed to treat all New York City's effluent; the city itself covers only 320 square miles. "The land area needed to absorb without pollution the 15 billion gallons of treated sewage of the U. S. daily would encompass 3,500 square miles, or more than Rhode Island and Delaware together," he points out.

Some communities are diverting effluent from nearby lakes to distant irrigation reservoirs used by farmers. Professor Hasler is a consultant to the South Tahoe Public Utility District, which raised $9 million annually and received a $10 million Federal grant to pipe treated sewage over the mountains into California rather than into Lake Tahoe in Nevada. He recalls, "At first the farmers weren't too keen on using 'night soil' to fertilize their fields, but they've discovered it doesn't smell that bad and is much better than commercial chemicals."

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*Director Stephenson of the Institute of Water Research at Michigan State University writes (Feb. 10, 1970) that construction of the facility will begin within a year; also that "it is not possible to unequivocally state that current treatment techniques will not assist in solving the pollution problems of tomorrow," . . . but . . . "additional measures beyond the institution of conventional treatment plants must be effected."

Some ecologists believe a useful stopgap would be dumping sewage far out into the oceans, well beyond the continental shelf. William Niering, a botany professor at Connecticut College in New London, suggests isolating sections of the oceans with plastic barriers for dumping contaminants. "We could create self-contained ponding areas that wouldn't spread sewage," he says, adding that the open ocean is now a "biological desert" that could absorb organic fertilizers without harmful pollution.

Ecologists concede that improving waste management will require huge spending. David Gates, a St. Louis ecologist, says such improvement would be "like fighting a major war," and would cost billions of dollars. He adds that while this sounds expensive, so, a decade ago did sending a man to the moon. "Attacking pollution is more important than space travel and we've got to abandon the notion we can't afford not to spend the money as soon as possible."

Most ecologists are discouraged over whether such funds will become available, for they see the Federal Government as the only logical source. Total national expenditures for disposing of solid wastes, both public and private, now run about $4.5 billion a year. Robert Finch, Secretary of Health, Education and Welfare, concedes that these outlays "have simply not been effective in preserving or improving the quality of our landscape." But he told a Senate subcommittee recently that the Administration wants industry rather than Government to pay for coping with the nation's growing mountains of trash.

Much of today's waste disposal, moreover, is inadequate even from the traditional standpoint of simple sanitation, let alone from the more modern perspectives of the ecologists. Federal officials say that 75% of the country's municipal incinerators are "unsatisfactory from the standpoint of public health, efficiency or protection of natural resources."

Instances of pollution by noxious substances also remain a serious problem. White perch caught in Chesapeake Bay were found to contain organisms that could cause typhoid fever, dysentery and tuberculosis. Coho salmon caught in the Great Lakes were found to contain dangerously high levels of DDT. ◆

". . . improving waste management will require huge spending." Such automobile graveyards are common in the country outside of most American communities.

In garden design consider

The Importance of Water

Carroll C. Calkins

Reprinted from The HOME GARDEN Magazine, May 1969.

PUT YOUR HAND over the pools in the photographs on the facing page and you may see a lovely rock garden in one and a tranquil woodland in the other. When you take your hand away, you will see the difference that the presence of water can make. And although you can see a difference, you are not able to hear the splash, savor the earthy fragrance or feel the cool caress on your hand while weeding on a hot summer's day. No question that water and gardens belong together.

This is not a recent revelation. Mankind's first discovery of the relationship of plants and water was the quick green color that sprang up after a rain, and that outlined the water holes and wet spots on the land. Then came the practice of trapping the water or moving it as needed. With this came the discovery of its beauty and its use in garden design.

Early Waterworks

The ancient Chinese, as might be expected of that phenomenal people, had magnificent water gardens. And so did their peers, the Egyptians, on the other side of the world. Examples exist of ancient Egyptian paintings that illustrate the importance of water to their gardens—for its beauty as well as for the life of the surrounding trees and for their sacred flower, the lotus, often shown growing in the water.

In the marvelous gardens of the Persians and the Moors, water was liquid treasure and used sparingly as single jets and narrow mirrored pools. Centuries later the Italian landscape designers used water with unbelievable exuberance in such gardens as Tivoli, Villa d'Este, Boboli, Villa Lante and, of course, in the tremendous fountains of Rome. Although all of the foregoing are classic reference points in the use of water in garden design, the most direct influence in this country has been that of England and, more recently, Japan. In the great days of English landscape design, under the influence of Humphry Repton and Capability Brown, water was used expansively (and expensively) in idealized imitations of nature. The stream shown here is in that tradition.

In Japanese gardens there is always water where possible. And if none is to be had, it is implied with a dry watercourse of river-washed stone, or carefully raked swirls of sand. The gardens are small. And small amounts of water are beautifully exploited.

It is the genius of our country, in many fields, to take the best from many sources and come up with something typically our own. American landscape architects and garden designers are known all over the world for the verve and practicality of their designs for extending the livability of the house into the garden. While outdoor living is not an American invention, we have certainly changed its style, and water is often an important element of the design. Examples abound in private and public gardens, and always in evidence there are remnants of China, Egypt, Persia, Italy, England and Japan reflected—in the water. It's one of gardening's pleasures to realize that, literally, there is a world of ideas from which to choose and to enjoy. ◆

Marjorie J. Dietz

There is almost unlimited opportunity for water gardening in the low-lying Netherlands. Double-flowered marsh-marigolds bloom luxuriously at the water's edge.

Molly Adams

A water course (foreground), designed and constructed to simulate a meandering woodland brook, embellishes the path which winds through this naturalistic garden.

Tracking down the giants among American holly trees

Big Hollies

John H. Gruver

Reprinted from the HOLLY LETTER, August 1969. Published by the Holly Society of America, Inc.

IN THE FALL of 1957 while visiting Longwood Gardens, Kennett Square, Pennsylvania, I was fascinated by a very large, nicely-shaped American holly (*Ilex opaca*) growing close to the main conservatory. I took a photograph of it with my wife standing beside it to obtain a perspective and show the size of this unusual tree. I later learned that this male holly had been purchased for $2400, in 1928, from Lewis and Valentine and had been moved from New Castle, Delaware, to the Gardens, a truly remarkable feat as even 45 years ago this was a large holly (24 inches caliper [75 inches circumference], 35 feet high, 25 feet spread). Today that tree is 59′ tall; it has an average diameter spread of 32′ and the trunk is 145″ in circumference 15″ above the ground where it divides into 3 trunks, which are 82″, 38″, and 69″ in circumference at 4½ feet (breast high).

This holly which was so much larger than any I had seen before made me wonder. Are there others this big? Where are they? Have any been specially recognized? What is the life span of holly? Is the wood used commercially and so on? Following my first interest, the dimensions of existing aged hollies, I saw and photographed the famous "Grandpappy Holly" of Pamlico County, North Carolina, which that State has officially recognized; a full-berried female in a field off Route 460, 3 miles east of the city of Petersburg, Virginia; and a male on Old Brook Road in Richmond, Virginia; three in all. Then about four years ago I decided to seriously study this subject and try to personally see, measure, photograph and learn as much as I could about the history, legend, and present state of preservation of each big holly. I soon determined that I had to set some standard or cut-off point as to what constitutes a "big" holly. A tree 20-30′ high with a trunk circumference of 36″ at breast height can be a magnificent tree and a joy to behold, but this was not my main interest. I was looking for the unusually large hollies, the patriarchal and matriarchal specimens that have lived here for centuries. With that in mind I established a dimension of 81″ in circumference (about 27″ in diameter) at breast height (4½′) and sought hollies at least that large.

Sources of Information

Now, how do you find out about hollies this big? My sources were varied. Mr. Daniel G. Fenton of the Big Tree Committee of the Holly Society gave me a helpful list with limited detailed information which I used as a starter. As a member of the American Forestry Association I sought their aid. Their publication *Social Register of Big Trees* lists the champ holly thus: "HOLLY, American, *Ilex opaca* (1964) 13′4″ 53′ 61′. Near Hardin, Liberty County, Texas. Billy Frank Eaves, Woodville." [Shown in order: Circumference at 4½ feet, height, spread, location of tree and nominator.] The AFA has a continuous campaign to locate and recognize the largest of native trees, and they revise their listing from time to time. Many hollies had been nominated over the years and Chief Forester Kenneth E. Pomeroy and Mrs. Lorna C.

Littlecott were very helpful in giving me much needed information about them.

Natural Range

The natural range of *Ilex opaca* is generally along the Atlantic and Gulf Coasts, from Cape Cod to Texas, parts of Oklahoma, Arkansas, Tennessee, Kentucky, West Virginia, southeastern Missouri, and southern Ohio. I wrote to many State foresters and foresters of National Forests in these States and received considerable help from them in locating unusually large hollies, or learning of their non-existence.

Holly Society and garden club members have helped, as have friends and acquaintances who just happened to know of a particularly large holly tree.

With the leads we had, and I say "we" because my wife assisted me, we asked for and obtained permission of the owners to visit, measure and photograph each tree. Most owners were very cooperative and delighted that their holly was of sufficient note to warrant the attention it was getting.

Some conclusions which I have drawn from my study so far are—

1. There is a very limited number of these fine old hollies, probably not more than 60 or 70 living today.

2. The beautiful white, almost grainless, wood of holly was once quite sought after commercially for inlays, scientific instruments and other uses. As a result, large hollies in forests were harvested and, almost without exception, the big hollies found today are at a court house, church, school, park, old plantation home or site, or similar spot where they were preserved.

3. For some reason which I cannot explain, the three largest hollies I have located (Hardin, Texas; Pamlico County, North Carolina; St. Marys City, Maryland) and the tallest (86′, Ellendale State Forest, Delaware) are all males (no berries).

Some of the most interesting, unusual or historical hollies are:

The "Champ" as recognized by the American Forestry Association, a beautiful spreading tree, 53′ in height, with an average diameter spread of 61′ and a breast-height circumference of 160″.

The "Grandpappy Holly" so well documented in the February, 1969, *Holly Letter*, with its 3-acre-plus Holly Arboretum. Preservation of this famous holly for future generations and the establishment of the Arboretum have been largely due to the untiring efforts of Holly Society past-president Jackson Batchelor.

Baltimore & Ohio Holly

The "Baltimore & Ohio—Chesapeake & Ohio Railroad" holly, 2 miles north of the Susquehanna River at Jackson, Maryland, which has become nationally famous for its Christmas lighting and ceremonies over many years.

The "Ku Klux Holly" of Union County, South Carolina, steeped in history and legend of the Reconstruction Period.

Hollies with a minimum of CBH of 81″ or multistemmed plants, which the author considers equivalent in size or age, are listed in the accompanying table. The age of holly is dependent on many factors such as soil fertility, climate, moisture, competition with other trees, and exposure. The author estimates a holly of 81″ to be anywhere from 140 to 200 years old. Each tree listed has been personally seen, measured, and photographed unless otherwise noted. Several large hollies, known to the author and on which he has incomplete information, have not been listed pending further study of them. Members and friends of the Holly Society of America are urged to bring to the attention of the Society any unusual interesting, and/or historical old hollies, and to do all they can to preserve and honor them.

The American Holly Society invites membership. Dues are $5 a year. Anyone interested should write to Bluett C. Green, Jr., Secretary-treasurer, P.O. Box 8445, Baltimore, Maryland 21234. The Society publishes two newsletters a year and has published several bulletins on holly.

(*Continued*)

American Hollies

Circum.	*Height*	*Spread*	*Sex*	*Location*	*Apparent State of Health*	*Remarks*
ALABAMA						
106″	49′	46′	(F)	Escambia County; 20 mi. W. of Andalusia; S. side of highway 29.	Good condition.	Checked by State Forester. Not seen by author. Have photo.
ARKANSAS						
89″	57′	35′	(?)	Jefferson County.		Information from State Forester. Biggest known in State. Not seen by author.
DELAWARE						
81″	86′	39′	M	Sussex County in Ellendale State Forest.	Excellent. Color of leaves quite dark.	*Ilex opaca* is the State tree of Delaware.
116″	41′	42′	(M?)	Dover; Eden Hill Farms, Ridgely Place.	Excellent but tree overgrown with poison ivy.	Sex uncertain.
GEORGIA						
109″	46′	48′	(?)	Off Georgia Highway 39, ½ mi. S. of Clay-Early County line.	Needs help of tree surgeon. Damaged by wind.	Blakely Garden Club interested. Not seen by author.
LOUISIANA						
83″				Rapides Parish, Woodworth on U.S. 165, 10 mi. from Alexandria.		Checked by Louisiana Forestry Assoc.; State Champion. Have photo. Not seen by author.
MARYLAND						
81″	40′	40′	M	3308 Rose Mary Lane, Hyattsville.	Excellent. Slight snow damage 1967.	Est. age 175 years.
82″	45′	30′	F	2 mi. N. of Susquehanna River off Rt. 40 on RR right-of-way at Jackson.	Excellent. Regularly fed.	Full of berries.
144″	51′	45′	M	St. Mary's College grounds. St. Mary's City.	Good. Some signs of deterioration.	Est. age 225 years.
81″	39′	36′	F	St. Mary's County, opposite Chopticon High School on Route 242.	Good. Field cultivated up to trunk of tree. Berries and leaves small.	Crown of tree nicely shaped.

123″	56′	34′	F	Anne Arundel County, Holly Road, Edgewater.	Excellent. Trunk repaired. Upper limbs guyed.	
102″	69′	40′	M	Adkins Estate, “Woodland” near Easton.	Good. Several burls on trunk.	
MISSISSIPPI						
92″	40′	35′	(?)	Near Waynesboro, property of Mr. Scott West.		Reported by Mr. Ed Blake. Not seen by author.
NEW JERSEY						
100″	60′		M	Garden State Parkway 4 mi. S. of Ocean City entrance.		Fence protects tree. Information from Dan Fenton. Not seen by author.
NEW YORK						
94″	27′	38′	(?)	Long Island, Southhampton. Farm of C. E. Dimon.		Mr. Dimon reports (April 1970) that tree is about to succumb to old age.
NORTH CAROLINA						
133″	72′	45′	M	Pamlico County near New Bern.	Good. Official holly aboretum established.	“Grandpappy Holly”, N. C. foresters est. age 206 years.
103″	65′	40′	M	Property of Mr. Cottrell near Louisburg.	Good.	30″ burl 12′ above ground.
97″	39′	36′	M	Bear Poplar, Rowan County, home “Woodgrove.”	Tree surgeons stated trunk hollow. Cannot survive many more years.	
81″	41′	39′	F	Southmont off Route 8, Davidson County.	Excellent. Beautiful tree loaded with berries.	
82″	54′	39′	F	Newsome, Tuckertown Lake, Davidson County.	Healthy. Well shaped, full of berries.	Original double trunk now grown together. Natural graft.
OHIO						
2 stems 66″, 59″	40′		(?)	Vinton County, Vinton Township near Carpenter.	Good.	Checked and photographed by Dr. O. D. Diller. Not seen by author.
PENNSYLVANIA						
3 trunks 82″, 38″, 69″	59′	32′	M	Kennett Square, Longwood Gardens.	Excellent.	145″ at 15″ above ground.

SOUTH CAROLINA

86″	38′	34′	F	Union County; 3.7 mi. past West Springs.	Color of leaves poor.	Ku Klux tree. Article "Union County News" 12/21/66.
5 stems 25″, 20″, 27″, 41″, 35″	38′	39′	F	Sumter County; RFD Dalzell, property Mrs. I'Ans Jones.	Very good. Unusual growth.	Est. 200 years.
9 stems 42″, 21″, 16″, 33″, 30″, 31″, 28″, 23″, 43″	45′	41′	F	Sumter County; RFD Dalzell, property Mrs. I'Ans Jones.	Very healthy. Unusual growth.	Est. 200 years.
98″	46′	32′	F	Sumter County, Rt. 3, property Mr. W. Loring Lee, Jr.	Part of tree dying (15 to 20′ of two top branches.)	Tree damaged by earth being stripped from base.
90″	56′	36′	M	Fort Hill, Campus of Clemson Univ., Clemson.	Very good.	Tree leans due to being crowded by large tulip poplar.
94″	63′	36′	M	Fort Hill, Campus of Clemson Univ., Clemson.	Very good.	Presumed planted by Mrs. John C. Calhoun about 1830.
4 stems 48″, 44″, 50″, 44″	7′	35′	F	Union County, 3 mi. SE of Pacolet, off State Route 176.	Very good. Healthy.	
87″	48′	32′	(M?)	Oconee County, off Highway 183.	Good. Fairly sound.	Sex in doubt. No blossoms in mid-April.
3 stems 48″, 41″, 63″	40′	41′	M	Oconee County, Near Oakway, near State Route 24.	Very good; good color; nice spread.	
84″	57′	39′	M	Union County, on Kennedy Mill road.	Very good.	Forks above 4½′.
135″	56′	39′	F	Near Newberry, ¼ mi. E. of I-26 on property of J. H. Phibbs, Sr.	Very good.	Divides into 4 trunks.
102″	48′	28′	(?)	Fairfield County, Winnsboro, State Routes 213 & 54.	Some die back, trunk has scars but no rot.	Checked by Area Agent-Forester Joe H. Phillips. Not seen by author.
104″	54′	43′	F	2800 Colonial Dr., Columbia.	Excellent.	Nominated by Mr. C. W. Hall. Not checked by author.
104″	53′	61′	F	Breeze Hill Plantation, Aiken County, 4 mi. SE of Aiken on Bank Mill Road.	Well shaped and owner says it has berries regularly.	Not checked by author.

TEXAS						
160″	53′	61′	M	3 mi. W. of Hardin, Liberty County.	Good.	Recognized by AFA as Champ. 5 slides received from John A. Haislet, Texas Forest Service. Author did not check.
VIRGINIA						
127″	31′	31′	F	State Waterfowl Refuge, Hog Island, James River.	Completely hollow. Trunk full of holes. Lots of berries.	Est. 300 to 400 years.
2 trunks 66″, 62″	58′	40′	M	Mt. Vernon.	Excellent.	Largest Mt. Vernon holly. Believed growing at time of George Washington.

American Hollies

Ku Klux holly; *below*: holly, Escambia County, Alabama.

California's Disneyland adapts an ancient horticultural skill

Topiary Gardening

Morgan Evans

Reprinted from the California Horticultural JOURNAL, January 1969

TOPIARY GARDENING, the art of fashioning living plants into the shapes of animals or geometric figures, has been practiced for centuries, if not millennia, and has both its advocates and detractors. One of the latter, George Nicholson, editor of the highly respected *Dictionary of Gardening* (1888), comments, "Although the absurd fashion of cutting and torturing trees into all sorts of fantastic shapes has hopefully almost passed away, some recognition is in order." Mr. Nicholson's sentiments were quite possibly well justified and no doubt were shared by many.

On the other hand, about three hundred years ago in England and Europe, topiary gardens were the pride and delight of royalty and landed gentry, and a number of notable examples of such gardens may still be seen there today. This very specialized form of gardening was never quite as fashionable in this country, and although formal shaping of hedges and columns in the Williamsburg tradition are not uncommon, plants in stylized geometric or animal form are rather few and far between.

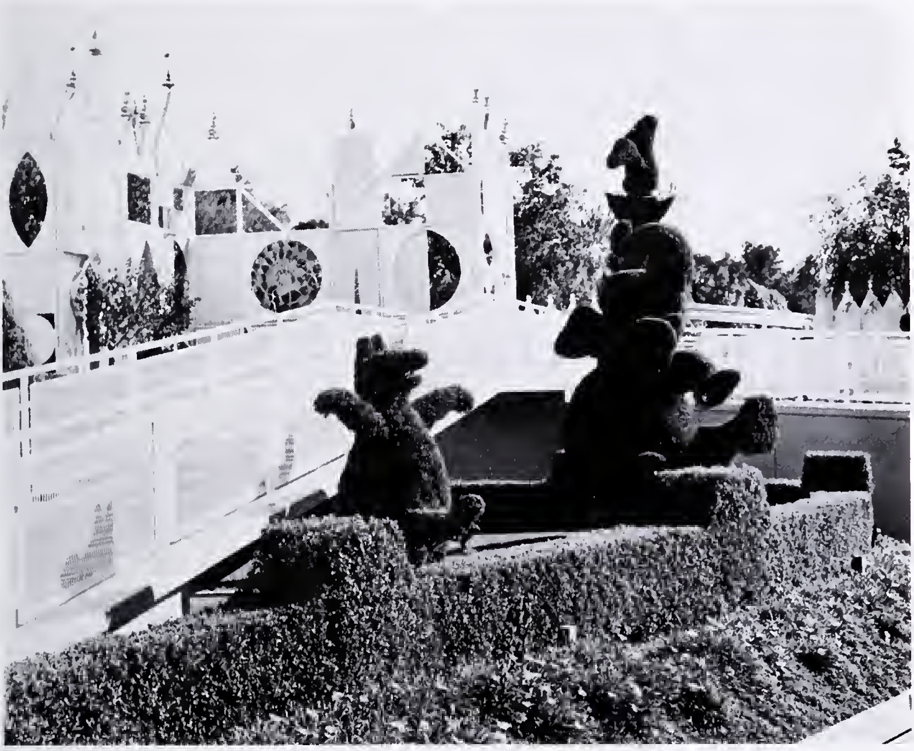
As practiced in Europe, the culture of topiary subjects depended upon long-lived and slow-growing trees and shrubs with appropriately fine-foliaged texture. Boxwood and yew were favored, though holly and laurel were also employed. As a general rule, plants were set out at an early age, carefully nurtured, and trained over a period of many years into the desired configuration.

A few years ago, under the personal direction of Walt Disney, a unique topiary garden program was commenced at Disneyland. In true Disney fashion, the figures to be produced were drawn from well-known Disney characters, such as Dumbo, the crocodiles and waltzing hippos from "Fantasia," etc. As true-to-scale reproduction would have resulted in figures too large for the garden they were to occupy, some compromise in size had to be reached. The resulting animals ranged from 2-foot poodles to 10-foot giraffes.

Disney artists produced expert drawings of the desired menagerie, which were then enlarged to actual size of the respective characters, but now came the sticky problem. The debut of this Disney troupe was scheduled for three years hence and normal topiary practices would have required many times that period to achieve the desired effect. The answer lay in starting with mature, rather than young plants, and coercing them into shapes that must have come as something of a surprise to the plant species involved.

The aforementioned full scale drawings became blueprints, in effect, and lightweight steel skeletons were fashioned to match the prints. Appropriate plant materials were assembled, through diligent search of nurseries far and wide, and stored in readiness for the next step.

Carefully constructed redwood boxes of varying sizes and shapes to accommodate the different figures were constructed. A special soil mixture was formulated to ensure adequate drainage and aeration and yet provide sufficient stability for the tallest subjects. Sizing up the drawings (in most instances 4 feet of the animal were called for, but occasionally a waltzing hippo or balancing elephant meant only one point of contact with the earth), the correct number of plants, perhaps two short and two tall ones, were



Disneyland's topiary figures were trained in three years from mature shrubs rather than young plants. For examples of East Coast topiary figures of privet, which were started 51 years ago and executed under traditional techniques, see pages 32-33.

placed in the proper box, which was then back-filled with the soil mixture. The steel "bones" of the selected animal were then joined to form this animal and securely fastened to the container. From this stage forward, the task consisted of progressively wrapping the main branches of each plant to the skeleton, trimming and tying as required. At the end of the three-year period, with few exceptions, the troupe was ready to move on stage.

Seeking as much variety in color and texture as practicable, a fairly wide range of plants was at first assembled. For various reasons, certain of these choices had to be eliminated, and the present roll call consists of *Myrsine africana, Syzygium paniculatum* (a compact form), *Cupressus sempervirens, C. glabra* 'Gareei,' *Thuja orientalis* 'Beverleyensis,' and selected forms of *Juniperus chinensis* and *J. scopulorum.* The formal hedges of varying sizes which define the topiary garden include *Ilex crenata* 'Green Thumb,' *Buxus japonica, Syzygium panculatum* (compact form), *Murraya exotica,* and *Ficus retusa.*

The training of these topiary figures is not quite as easy as it might sound. Vertical progress is no great problem, but growth must be induced horizontally and downward as well, in order to achieve the desired form. The three-dimensional shapes invariably create shaded areas, so that healthy growth in the upper surface of the extended limb is a much easier matter than the underside. The constant shearing required to suppress growth is not always enjoyed by the plant, and extreme care must be taken to avoid exposing woody cuts. Plants are subject to normal attack by various insects and diseases, which can cause disproportionate problems where every square inch of surface is important. Continual growth is desirable to sustain the more difficult exposures, but, of course, can become a problem when it quite naturally seeks the more comfortable upper surfaces. Watering, that most sensitive aspect of successful plant culture, can make or break a project. Throughout the three-year period that the plants were held in containers, tensiometers were a regular fixture for every animal. Where four individual trees comprise one large figure, two or more tensiometers were necessary to guide the gardeners charged with their well-being.

Today, visitors to Disneyland, nearly nine-and-one-half million per year, are welcomed to the "It's A Small World" adventure by a waltzing hippo poised on one toe (*Thuja orientalis* 'Beverleyensis'), flanked by a poodle and a pig (*Myrsine africana*), and back-dropped by an array of bears, elephants, seals, and giraffes, twenty in number—inanimate, but alive and well. The same gardeners who patiently nurtured the members of this circus troupe through their formative years are now responsible for their care and feeding. Evidence of their earnest effort is to be found in the happy appearance of their charges. ◆

ANOTHER PRIZE-WINNING FILM FOR GARDENERS

A 16MM FILM, "Planting and Transplanting at the Brooklyn Botanic Garden," has been produced in color and sound for the Brooklyn Botanic Garden Women's Auxiliary by the Center for Mass Communication of Columbia University Press. The Garden's second prize-winning film has received the following awards: C.I.N.E. Golden Eagle Award, 1969; Award of Merit, International Film Festival, American Horticultural Society, 1969; Award of Participation, Venice Film Festival, Italy, 1969.

The film demonstrates the essential techniques of planting and transplanting (from seeds to fully grown trees) amidst the beautiful vistas of the Brooklyn Botanic Garden in all its seasons. It was filmed under the supervision of the late Miss Alys Sutcliffe, Horticulturist *Emeritus* of the Botanic Garden from a script prepared by Kenneth Bruffee.

The film offers an ideal 22-minute presentation for garden clubs, horticultural groups and civic organizations of all kinds and is available for rental from the Brooklyn Botanic Garden or from many local libraries and film libraries. It may also be purchased for permanent use for $252 from the Center for Mass Communication, Columbia University Press, 440 W. 110 St., New York, N.Y. 10025. The first Brooklyn Botanic Garden film, "Pruning Practices at The Brooklyn Botanic Garden" can be purchased for $264 and can be rented from the same sources mentioned above.

The practice of weaving patterns on the ground is nearly as old as the history of man . . .

Pygmy Hedges

Charles W. Cares

Reprinted from HORTICULTURE Magazine, June 1969

PLANTS lined into low hedges have been used to create garden patterns for at least as long back as the Roman Era.

The practice of subdividing gardens into many smaller rectangular subdivisions was widespread during medieval days. The castles provided suitable perches and elevated positions from which the spectators could look down upon and appreciate the patterns thus created. The areas which could be devoted to gardens within the castle walls were understandably small. Control and order were important.

The culmination of this style was in 16th and 17th century France with the geometric contrivances of such gardeners as Boyceau and Claude Mollet, gardener to Henri IV, even though viewing platforms had to be especially contrived for the flat landscape and the size of the areas was no longer limited to fortifications. Gardens designed in this ultra formal manner are known as parterres. Since then parterre gardens have had their ups and downs with the arbiters of taste and fashion.

In 18th century England, however, they were definitely down as popular features but in the 19th century the idea was revived with modifications and was known as carpet bedding. This device was seen frequently in America, and still is in formal parks, at cemetery entrances and as arabesques on the grass in front of city halls and depots.

Cities today are in certain respects similar to yesterday's castles. The upper floors of multi-storied buildings provide perfect vantage points from which to look down upon designs. The intricacy of such designs is more clearly seen and appreciated from above than from the ground level, although even simple hedges bordering walks add interest. Many of the courts which result from meeting the need for light and air in building complexes become neglected micro deserts when they might be made interesting.

Plants to be used in hedges have requirements over those usually demanded elsewhere. Hedges are more vulnerable to the spread of disease than isolated plants. A fungus disease affecting one plant may spread rapidly from plant to plant because the branches touch each other. They must also be able to stand crowding and competition from adjacent plants to perform well. Further, they must grow uniformly and it is helpful if a hedge plant does not grow fast. A plant which grows fast usually has higher maintenance requirements if it is not to appear ragged and unkempt. Gaps in hedges caused by the death of plants of uncertain hardiness or plants temperamental in their horticultural requirements are difficult to repair.

The Value of Yews

One of the outstanding plants to use in making a pygmy hedge in the northeastern part of the United States is the dwarf Japanese yew, *Taxus cuspidata nana.* This yew is not only slower in growth rate than many other plants but it has shorter, thicker leaves than most other yews. All yews, however, have usually good features which recommend them for hedge use and they have been used historically for this purpose. It is possible to hold any one of them as a diminutive yet healthy, leafy specimen by shearing. They regenerate new leaves even when cut back to older wood. So, it is possible to bring them back to scale even after neglect.

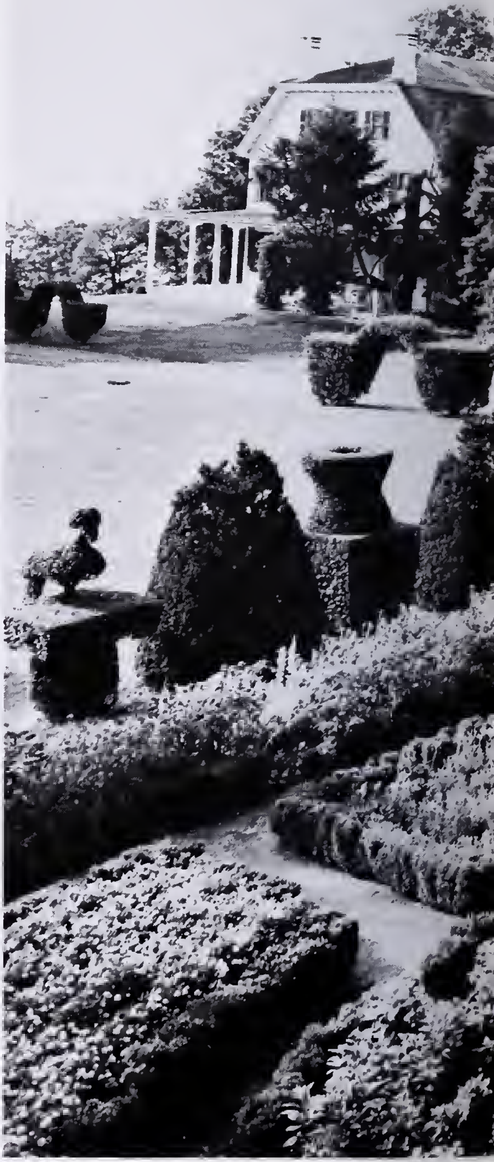
The yews meet equally well the other criteria stated above. They flourish in many soils but do demand good drainage. The bright red fruits borne on the pistillate plants provide a conspicuous seasonal bonus in late summer and autumn if plants of both sexes are present. On top of all this, yews are almost as permanent as any plant known. There are many yew plants alive in England today which must date back to the Middle Ages. Finally, two of the greatest of the virtues of this genus is its tolerance of shade and paucity of pests.

Boxwood

Where it is hardy the plant par excellence to use as a pygmy hedge is dwarf English boxwood, *Buxus sempervirens* 'Suffruticosa.' However, since other boxwoods take shearing well, practicality and budget may suggest using *B. sempervirens* or one of its cultivars and keeping it cut to optimum size. In the Midwest and cold areas where boxwood is uncertain, one might seek the hardier cultivars such as *B. sempervirens* 'Inglis,' or *B. s.* 'Welleri.' Plants of these are known to have withstood severe conditions for 30 years or more. In borderline situations where standard boxwoods are in danger these plants might be relied upon to perform safely, especially in favorable microclimates.

The Korean and Japanese varieties of little-leaf box, *B. microphylla*, are also hardier than the species mentioned above. They, as well, should be considered for border line situations. Their foliage has a slightly yellow cast, however, which might be considered to be either an asset or an objectionable feature depending upon the circumstances and the value placed upon it by the critic.

Japanese holly, *Ilex crenata,* and many



Bill Allen from N. Y. Times Studio

A dwarf boxwood hedge encloses formal garden beds and topiary forms at home of Miss Alice Brayton, Portsmouth, Rhode Island. Garden is 51 years old.

of its forms are highly suited to hedge use. Superficially it resembles boxwood. It is usually alleged to be hardier than boxwood, but this has not always been found valid in the experience of this writer. However, *I. c.* 'Hetzii' has proven exceptionally good.

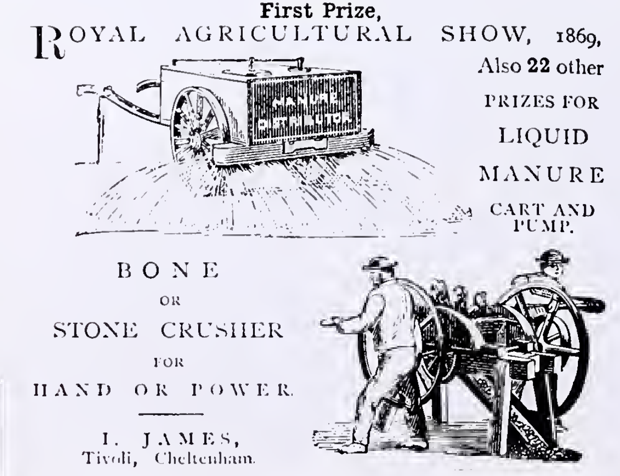
An elegant and unusual pygmy hedge can be constructed by placing stakes with wires or strings in the form desired and then weaving the long runners of English ivy, *Hedera helix,* around the wires and subsequently intertwining the runners themselves. While the hedge will require clipping to keep it trim and compact, ivy is quick to grow and easy to use to form knot designs.

The plants mentioned above are all evergreen. Some deciduous hedges should also be considered in that they are thick enough to be attractive even without foliage. The very common dwarf Japanese barberry, *Berberis thunbergii* 'Minor,' is an outstanding plant in this category. *B. t.* 'Erecta' is another good one. The alpine currant, *Ribes alpinum* or, if available, its rarer, more dwarf form, *R. a.* 'Pumilum,' meets all of the standards set up for judging hedges. One should use the male plant as the pistillate form may be a carrier of white pine blister rust.

All of the privets are easy to keep low by shearing. They have been used in sheared hedges so often that some people fail to recognize them when they see them growing in their natural growth habit, expressing surprise that they grow into handsome specimens when permitted to grow freely. Some others, less often seen but possible to use, are *Viburnum opulus* 'Nanum,' Canby's pachistima, teucrium and the dwarf blue-leaved Arctic willow.

In a hedge the characteristics of each individual plant are subjugated to the whole and one should not be conscious of the species at all. For example, one does not see a line of yews, boxwood or barberry. One sees a background, an edging, a device giving pattern and interest, a low barrier or, at least, an organizing element in the garden. The species of plant making up a hedge is of little interest so long as it meets the design criteria for texture, vigor and those other standards noted.

Most of the comments on design have been concerned with traditional forms of parterre gardens. The traditional patterns are also ancestors of similar contemporary uses. Since pygmy hedges are the means of creating design the opportunities are boundless, limited only by the extent of one's imagination. For instance, shaping plants for topiary and hedges is an ancient horticultural skill. Today's cities with small spaces available for gardening and a new regard for urban spaces make an interest in this design use of plants entirely relevant. ◆



First Prize,
ROYAL AGRICULTURAL SHOW, 1869,
Also **22** other
PRIZES FOR
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PUMP.

BONE
OR
STONE CRUSHER
FOR
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I. JAMES,
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FOR SALE

100 years ago in the Gardener's Chronicle & Agricultural Gazette, London

Start with plants shaped by nature

Stalk the Wilds for Unusual Bonsai

George F. Hull

From the NEW YORK TIMES, Nov. 30, 1969. © The New York Times Co. Reprinted by permission.

TODAY, in this country, native trees collected from the wild and trained by American hobbyists are becoming show stoppers at bonsai exhibitions. These small specimens are miniatures of large trees, which under the buffeting of nature, have developed some stalwart qualities of their own. The notable trend is the great skill with which hobbyists transplant these older, naturally dwarfed specimens successfully and train them in an age-old art adapted from the Japanese.

Every part of the country has potential bonsai specimens. Alert eyes can find them almost anywhere in old pastures, along fence rows and in abandoned orchards. An outstanding bonsai specimen was trained from an apple tree less than 2 feet tall. The massive, gnarled trunk suggested the proportions of an aged giant. Carefully dug from its location on an old Connecticut farm, this tree was trained to develop a healthy root system in a shallow container, and a natural, twiggy top growth with smaller leaves.

Those who collect bonsai from the wild should heed a few warnings. *First* removal of plants from private property, or public lands without permission is theft. Responsible hobbyists can often get permission to dig plants on both private and public lands if requests are made to owners or the proper authority.

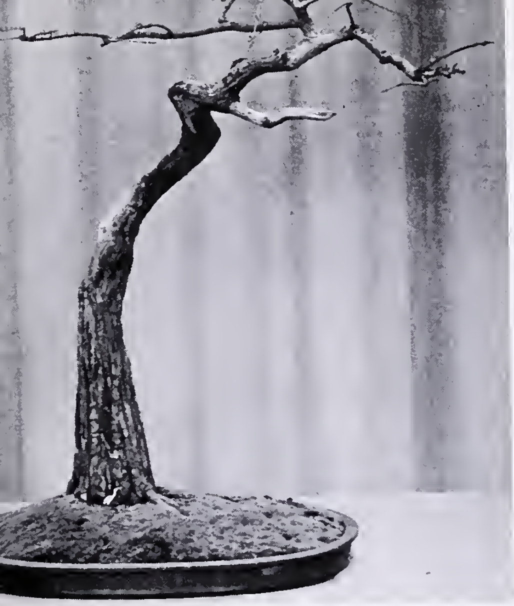
Second warning: Collecting of plants from the wild is a deed that requires skill and patience. Plants lacking the vigor of youth are difficult to transplant. While the above-ground parts may be small, the roots may prove long. The usual procedure to establish wild plants for bonsai is to transplant them to the open ground in the garden or a very large container to be grown there for two to three years before actual bonsai training begins.

Wild plants may or may not actually be very old. Some are truly stunted old plants. They are the most difficult to transplant. In most cases, unfavorable conditions have made these plants assume characteristics that mark them in their battle with nature.

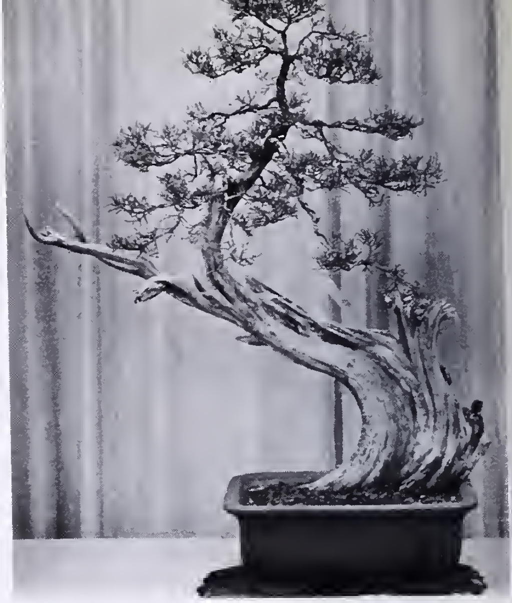
Bark may be stripped away by lightning, branches broken by wind and snow. Apple wood, exposed to the elements, tends to decay. An old tree may become a hollow shell, yet sprout new blooms and foliage each spring.

Other species, especially conifers, react differently. Exposed wood may weather a silvery white and remain so for centuries. Junipers are notable for their ability to survive despite damage. Native species on both coasts of this country have been sought by collectors. Among several kinds adapted for bonsai is *Juniperus californica,* sometimes called the California shimpaku because it resembles *J. chinensis sargentii.*

Good hunting is found in the desert areas of the West, where bonsai plants are "gathered," rather than "collected" as they are in the East. Plants with twisted trunks, partially stripped bare and weathered like old driftwood, are prizes. Sometimes these evidences of near-disaster are man-made. One case history

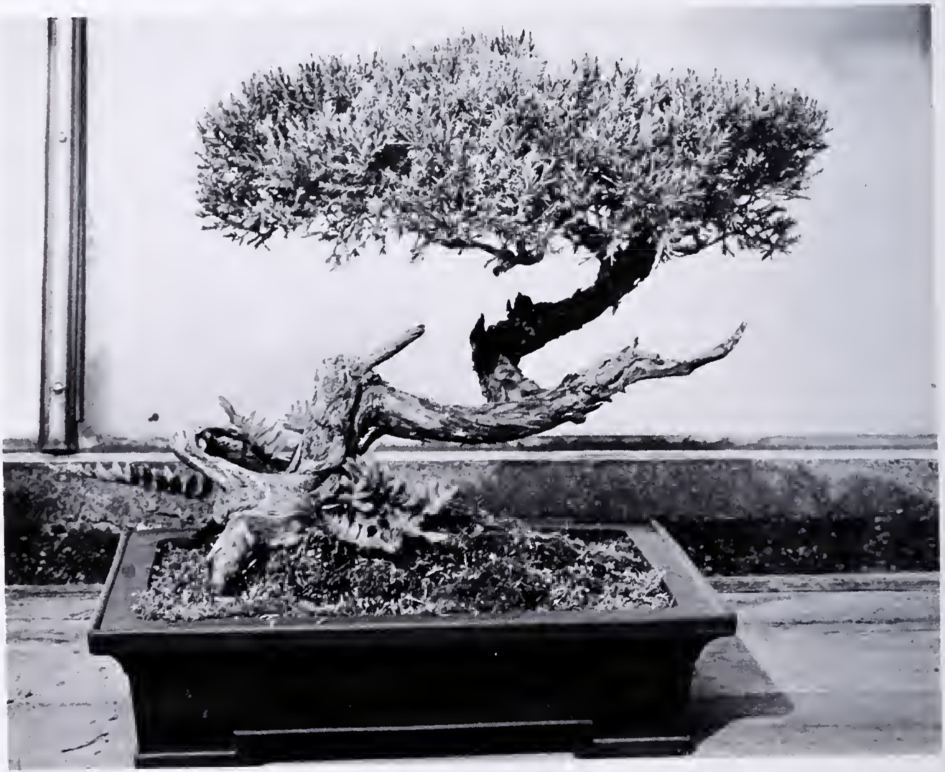


The dignity of bald-cypress is maintained in this asymmetrical 28-inch bonsai.

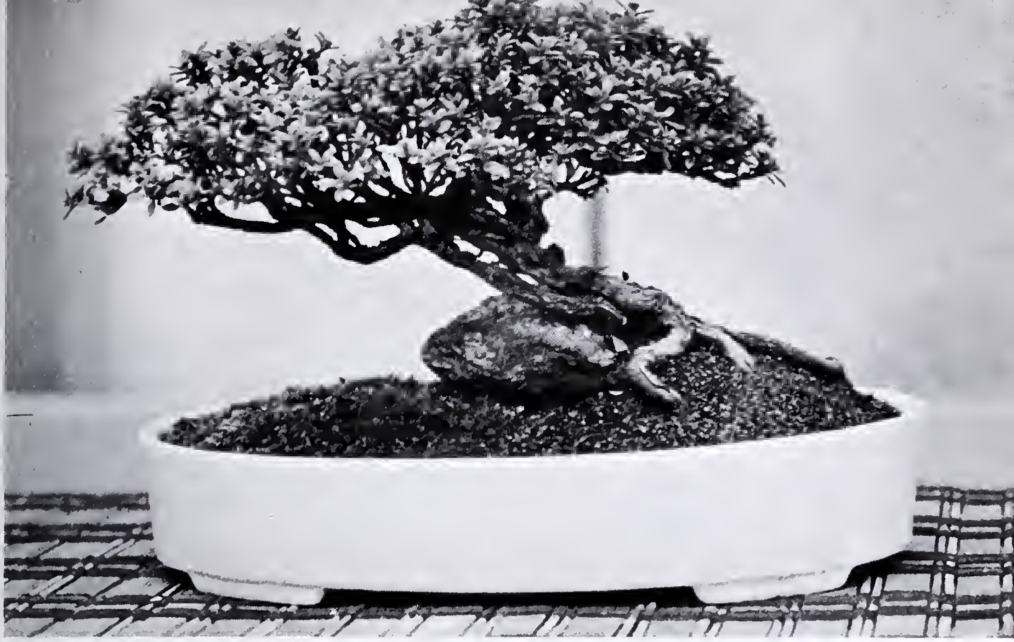


This aged and weather-worn California juniper conveys the spirit of bonsai.

Photographs by George F. Hull



The common red-cedar of the eastern United States, ordinarily an upright tree, occasionally develops an asymmetrical weather-worn form—a good bonsai candidate.



The dwarf sand-myrtle grows naturally in bonsai proportions. This 5-inch specimen was collected in the higher elevations of the Great Smoky Mountains.

of a juniper shows that it was originally a fairly large shrubby plant, rescued from the path of a planned freeway. This plant had a thick trunk gracefully curved and with a splay of sturdy roots at the base. Its owner cut it back to 18 inches and peeled the bark from the trunk in front to make it look like a storm-wracked specimen. Low branches at the rear, fed by the remaining bark, were pruned and wired to develop as a new and lower crown of branches, in the same way that the juniper would react naturally to such injury.

The Eastern red-cedar (*J. virginiana*) found throughout much of eastern United States is another bonsai favorite. Under normal conditions, young trees are symmetrical and are sometimes used as Christmas trees. In sandy and rocky locations, however, miniaturized versions of aged trees may be found.

Bald-cypress (*Taxodium distichum*), a native most frequently seen in Southern swamps, is another species that adapts to bonsai culture. Despite its usually wet habitat, this tree needs no more water than usual. Assets are a naturally tapering trunk and an ability to sprout new branches wherever pruned.

A rare plant that grows naturally in bonsai proportions is the dwarf sand-myrtle (*Leiophyllum lyonii*) which is found in the higher elevations of the Smoky Mountains. Unlike its more common relative, *buxifolium,* this species seldom grows more than 10 inches tall, often less. It is an evergreen that bears small pinkish blooms.

Although limited to a small area, collecting this natural dwarf is not the main difficulty. Transplanting often is simple enough, as these plants may be growing in small pockets of soil atop rocks, or in a layer of humus on the "heath balds" of the Smokies where rhododendrons grow. The challenge is adapting the dwarf sand-myrtle to different climatic conditions at lower elevations. Successful growers believe that misting the foliage frequently, especially in the evening, is important. This reproduces, to a degree, the normal climate of the mountain peaks where clouds repeatedly moisten the foliage when there is no rain and the roots are dry.

A reading list of available books and membership information may be obtained from The American Bonsai Society, Bedford, N.Y. 10506. ◆

Protection Pays at the Base of a Tree

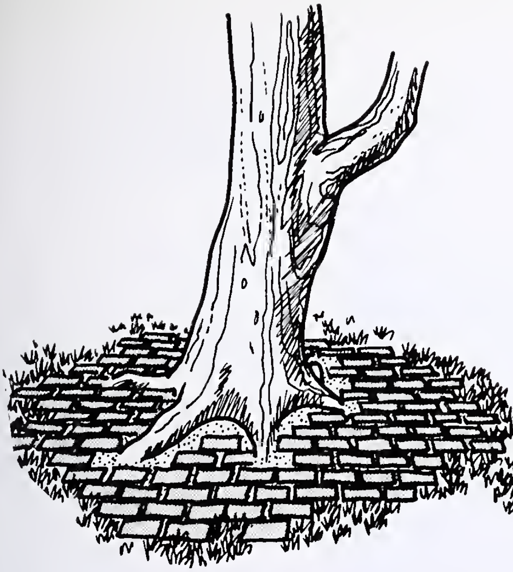
Reprinted from The HOME GARDEN Magazine, April 1969

IN ADDITION to the practicality of these ideas, they add to the importance of a tree. This is especially valuable for those trees you see every day—near a terrace or entry way or in view through a favorite window.

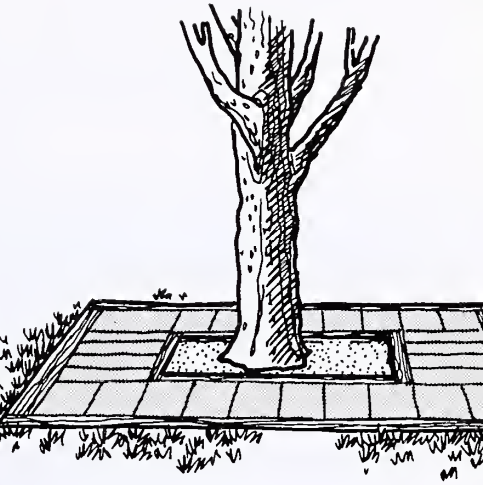
If you have had to trim much grass around the base of a tree by hand, or have ever nicked the bark with a mower, you know the value of a hard edge flush with the ground for the mower wheels to run on.

Inert materials will conserve moisture in the ground, stabilize soil temperature and help keep down weeds, while ground covers need extra plant food and water to compensate for competition of the tree roots. ◆

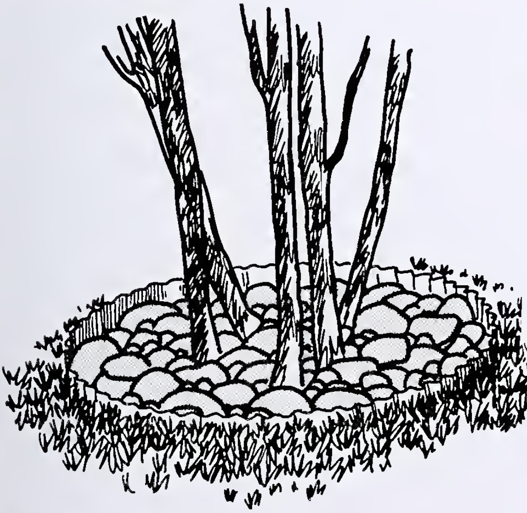
Wood rounds are appropriate at the base of a tree. Annual rings, the dominant pattern, are reminders of the phenomenon of growth.



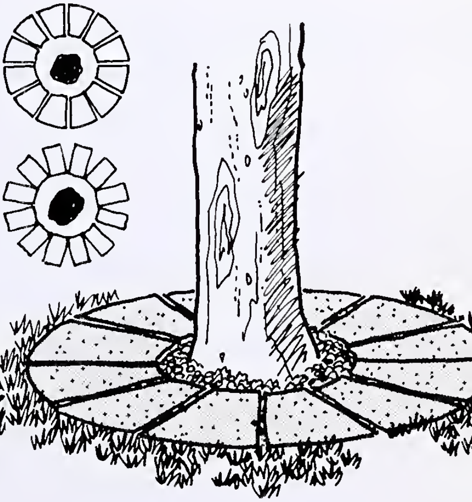
Bricks in ground set in straight lines (running bond) but with a ragged outer edge provide an effective balance of formal and informal design. Brick is best set on sand with sand between joints; weeds then pull easily.



Neat, orderly and easy to maintain is this wooden frame to set off a tree. The 2 x 4 wood headers on edge are flush with ground for a mowing edge. Surrounding brick is laid on sand. Use sand, fine gravel or moss around tree.



River-washed stones are another natural material uniquely suited to this use. Contained as the area is with a circle of metal edging (don't make the circle too small), tamped gravel could also be used.



Good project for craftsmen is the making of concrete blocks to surround a tree. Cast in tapered or rectangular form as shown, they should be at least 3 inches thick. Spray of water before concrete has set will reveal the texture.

Gardening Without DDT

James B. Kring

Reprinted from HORTICULTURE Magazine, November 1969

THE successful manipulation of plants and insects in the home garden, with or without pesticides, requires serious thought. We must decide which variety to grow, whether to spray or not to spray, which spray to use and how much insect damage we will accept. In any case, sensible insect control will help.

What do I mean by sensible insect control? This is nothing more than learning to live with insects. A true garden is not a zoological desert. It is an area where we learn to know plants and animals and where we attempt to manipulate them for our purposes. Learning to know insects is a difficult but not an impossible task and it is full of delightful challenges.

For a number of years DDT has been a useful tool. But DDT, like any pressure applied to the environment, created other problems. These side effects are now considered serious enough that this tool is being laid aside.

The question immediately arises: How can we replace DDT? There is at present no replacement for DDT. Any similar insecticide that replaced DDT would probably create the very same or more serious problems. The residual persistence of DDT in the environment gave long term control of certain pests. This long term persistence also permitted DDT to be picked up and, in some cases, accumulated by other organisms in the environment. There are substitutes for DDT but these are more expensive, more difficult to use and, therefore, are often less satisfactory. The newer synthetic substitutes persist for much shorter periods.

Diazinon, malathion, and carbaryl (Sevin) are frequently substituted for DDT. None of these, by themselves, are effective against all the kinds of insects that are susceptible to DDT. However, various combinations of these will kill most of the pests. Malathion and diazinon are toxic to some insects that were not controlled by DDT. Many insects are naturally resistant to each of these insecticides and other species have developed or will develop resistance to them.

Sevin, like DDT, will control many chewing insects such as Colorado potato beetles, flea beetles, cutworms, corn earworms and the adults of several grubs. Sevin is also effective against a few kinds of sucking insects, namely leafhoppers. However, again like DDT, Sevin will permit the development of certain aphids and mites on many vegetables and flowers.

Diazinon is moderately effective against the chewing insects listed above and, properly used, very effective against aphids and many kinds of sucking insects. Diazinon is also effective against a number of leaf mining insects. Malathion is not very toxic to chewing insects but it does control many kinds of sucking insects.

Each insecticide may burn or otherwise injure plants when used at high concentrations or at the wrong time. Directions are carefully detailed on the labels—these precautions must be followed.

If you desire to use some of the newer insecticides but are unwilling to avail yourself of all the specific information concerning the use of each in the garden, then I suggest you use some of the all-purpose mixtures that are available.

If you wish to spray or dust but prefer to avoid using these newer insecticides, I suggest the use of rotenone and pyrethrum mixtures. Rotenone is effective against most chewing insects and pyrethrum will kill most of the sucking ones. These are good insecticides and combina-

"A garden free of pest insects would be a garden empty of challenge"

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Insect pests can be especially troublesome in a vegetable garden *(right)* and in a rose garden *(below)*. The author recommends a rotenone-pyrethrum combination for coping with pests of vegetables. The insecticide Sevin controls many harmful pests of roses, including Japanese beetles.

Marjorie J. Dietz

tions will protect most plants from many kinds of pests. Cutworms, wireworms, radish and cabbage maggots are a few that are not satisfactorily controlled by these pesticides.

Further, there are many excellent books and articles on insect control to guide both the general gardener and the specialist. For both, the books by Cynthia Westcott are a must.

Gardening without sprays can sometimes yield excellent results but a knowledge of the progressive development of insect life in the garden is necessary. (It is also important to note that there are certain insect-susceptible plants that cannot be grown in the garden without sprays at the present time.) On this there are several good books and other literature to guide you. While some of the suggestions given are not effective, many of the cultural methods for insect control are excellent. Proper fertilizing, use of mulches, resistant varieties, traps and barriers and the encouragement of parasites and predators will reduce the need for synthetic insecticides. Proper nutrition with either organic or chemical fertilizers will, likewise, produce healthy plants that are more likely to ward off insect attack.

Mulches, as I have already discussed (HORTICULTURE, May 1969), have plus and minus values. Some mulches, like aluminum foil, will reduce certain insect problems, especially those caused by aphids, for reflected light from the sky seems to confuse these pests.

Traps and barriers around susceptible plants will usually help protect them from insects like cutworms. In addition you should carefully select from your seed catalogs the varieties most resistant to diseases and insects. For example, examination of a seed catalog tells you that Premier strawberries are resistant to leaf spot, leaf scorch and tolerant of virus and that virus-free raspberry plants are available. Spraying or dusting only when and where it is needed will protect parasites and predators and let them keep order.

Care can avoid insect problems. DDT has long been used for prevention and control of dogwood borer. Most infestations occur where the bark of the tree has been either injured by careless use of a lawnmower or by branch removal. Painting wounds with tree paint often prevents infestation and makes the use of an insecticide unnecessary.

A garden free of pest insects would be a garden empty of challenge. When necessary, use pesticides, but do not attempt to eliminate insects from the garden.

Much has been written about praying mantes and ladybird beetles. Under certain conditions their use can be effective but, to date, the use of other predators by home gardeners is virtually unknown. Also, we have hopes that new materials will sterilize or otherwise interfere with the normal life processes of some of our harmful insects but this, too, is for the future. ◆

How a Well-known Pear Received Its Name

IN 1770 an English schoolmaster named Stair found a superior pear seedling which he delivered to a Middlesex pear breeder, Williams. The breeder called the new pear 'William's Bon Chrétien.' In 1797 or 1799 Thomas Brewer received a grafted plant of this variety from England and planted it on his land in Roxbury, Massachusetts.

In 1817 Enoch Bartlett of Dorchester bought the Roxbury property and noticed a distinctive pear tree growing on it. Unaware that it was really 'William's Bon Chrétien,' he permitted the tree to be propagated under his own name. Hence, even today, in America we refer to the Bartlett pear, a variety still known in England as 'William's Bon Chrétien' or, simply, 'Williams.'—*Frederick McGourty, Jr.*

Unless control techniques are practiced at each stage of its life cycle

APHID Spells Trouble

Reprinted from GROUNDS MAINTENANCE Magazine, February, 1969.

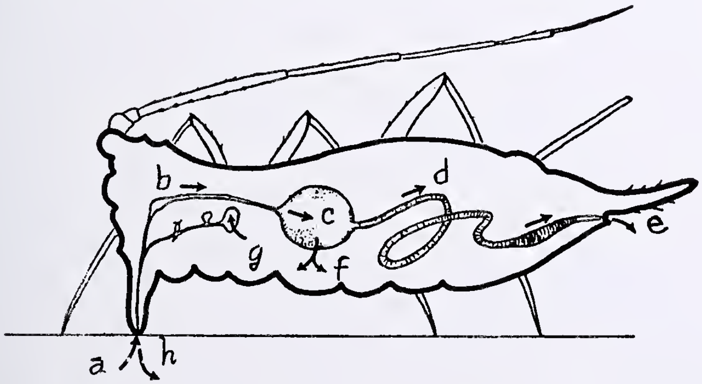
APHIDS are far more damaging than their minute size indicates. Related to leafhoppers, cicadas, scale insects, mealybugs and other homopteran insects, they have piercing, sucking mouthparts. This means that they feed by jabbing a stylet deep into host-plant tissues to suck out the juice. Often this specialized feeding apparatus is poked directly into the vein of a plant. As aphids are found usually in large colonies, this combined injury—the physical wounding and subsequent sap removal—to young shoots often results in malformed, distorted growth.

Worse yet, through mid-spring and late summer months, actively feeding aphids are winged. All too often they feed on a virus-infected plant, then fly to a healthy one to continue feeding, carrying the virus infection on contaminated mouthparts to the second host. In effect, a winged aphid, like all winged homopterans that have perfect mouthparts, is a flying hypodermic needle loaded with plant disease (usually virus) organisms.

Aside from feeding and disease-spreading activities, aphids cause other problems. The woolly aphids group causes various cankers, galls and varied forms of root injury. Frequently, woolly aphids spend a portion of their life cycle underground. The common aphids attract ants, supply growing medium for sooty mold and make a spotty, sticky mess of terrace furniture, automobile and building finishes through their honey-dew production.

Honey-dew Production

Let's look at this honey-dew business for a minute. In feeding, aphids ingest sizeable quantities of sap that is largely water. They extract certain nutrient elements and excrete the excess water containing some sugars and waste materials. These excreted droplets fall as "honey-dew." Stand to the south of a large tree



A virus may be borne on an aphid's stylets or ingested with food (a). If ingested, it travels to the stomach (c) through the esophagus (b), then passes out the hindgut (d) and is voided with the honeydew (e) or passes through the stomach wall (f). Once in the body cavity, virus moves in the aphid's blood until absorbed by the salivary glands (g) and injected into plant tissue with the saliva (h).

on a quiet spring evening and look north. The horizontal rays of the sun from the west will shine under the tree where you will be aware of a continuous mist of honey-dew droplets falling from the thousands of aphids feeding overhead.

Honey-dew draws ants which feed on it. It collects on leaf faces and other horizontal surfaces which soon become sticky and coated with a gritty, black disfiguring fungus called sooty mold. Even though the mold feeds on the honey-dew, it has a smothering effect on the leaves and can ruin the finish of painted surfaces. Certain ants so appreciate the honey-dew that they herd aphids around like cattle, moving them from plant to plant, and even carry aphid eggs underground for over-winter storage to be lugged out again the following spring.

The life cycle of aphids is rather complex. Variations occur since some aphids are highly specialized. But the general theme is the same. Eggs overwinter on twigs or tucked into bud-scales where they hatch in early spring as plant growth resumes to produce a few generations of wingless females. The population expands vastly as these females give live birth parthenogenetically (no sexual union involved) to more wingless females.

Toward mid-spring some of the winged offspring fly to other feeding sites, usually a fairly specific secondary host plant typical for the particular species of aphid. The wingless females spend the summer months feeding and producing more generations of wingless female aphids. Late in the summer winged males and females are also produced parthenogenetically. These fly to the primary plant host and mate during the autumn months. The females lay eggs that carry the species through the winter. In southern areas aphids may forego this sexual cycle and continue reproduction by live birth throughout the year.

Aphids cause stunting of buds and stems and a general loss of flowers and healthy growth on ornamentals. They may also introduce weakening viruses into a clean planting. They are especially bad on roses, chrysanthemums, nasturtiums, snap-dragons and a number of perennials. In spring and fall they cause problems on woody plants, particularly of the apple family, including the flowering crabapples, hawthorn, pyracantha and the spireas. Galls caused by aphids disfigure witch-hazel, elm, poplar and other trees. The familiar marble gall on the leaf stems of cottonwood and poplar trees houses a family of woolly aphids.

Control Measures

There are several ways of reducing the aphid population; none is perfect. Control techniques must be practiced constantly.

Dormant spraying is important. If the planting includes the apple-family relatives listed above, spray in early spring when the bud-scales are loosened by burgeoning bud growth but before any green shows. Use dormant strength lime-sulfur, or, on some species, dormant oil. If the overwinter aphid eggs are caught with a thorough dormant spray, aphid problems will be reduced greatly throughout the entire summer.

Insecticide applications when plant shoots are almost fully extended but still soft and succulent is the next critical step. Watch for aphids on new rose canes when they are about a foot long. Check the shoots of crabapples. As the candles expand on white pines and new growth lengthens on pin oaks, watch for that devastating, giant black aphid (up to ⅜ inch long) that will suck the life from new, tender tissues.

Spraying is a successful control method. The organic phosphate sprays are extremely effective. Be aware of two sources of trouble when spraying. First, unless spray chemicals are carefully measured and properly applied, they may distort tender, new growth, causing a crippled appearance through the entire season. Secondly, as birds are nesting at this time, you may draw fire from various humane organizations. The use of root-applied systemic insecticides is a good way to avoid both problems. Application can be made on rainy or windy days, too.

Check with your supplier for detail sheets on Di-Syston and Meta-Systox-R. In public areas it is a good idea to use a systemic insecticide solution pumped through a root feeder into the root zone of plants. A granular, surface-applied form may be used; water it in and cover the area with a fresh mulch for added insurance.

With the onset of hot weather the focus changes from woody plants to tender, herbaceous ornamentals. Usually flower beds and shrub borders can be sprayed safely with a contact insecticide. If the problem persists, a foliage-absorbed systemic insecticide may give a month's to six weeks' protection. There is little point to good spring spraying unless it is followed up throughout the summer.

Eradicating weeds that serve as secondary hosts is another worthwhile technique. For example, the rosy apple aphid that attacks roses, crabapples and many other desirable ornamentals prefer to spend the summer months on narrow-leaved plantain. It may be worthwhile to apply a broad-leaved herbicide to a neighbor's abandoned weed patch, a possible breeding ground for pests. Watch for aphid-covered weeds and take special pains to eradicate these species.

Autumn dormant spraying is not too effective as an aphid control. The newly laid eggs are carefully hidden in tight bud-scales and in bark crevices where chemicals may not reach them. Also, the egg shells are tough, leathery and impervious, not having weathered to any extent. Better save energy for a renewed spring campaign.

Biological Control

Biological control is used commercially for reducing aphid infestations on certain crops, notably large acreage carrot plantings in the truck-gardening area of California. In this case ladybird beetles are collected where they aggregate in the mountains and are held in cold storage until needed. Then they are dumped by thousands in the carrot fields.

So far the biological technique has not been extended to mixed ornamental plantings to any degree. However, a number of insects do reduce the aphid populations. Aphids are parasitized by braconids and chalcids that lay eggs on aphid hosts. Ladybird beetles, lacewings and the larvae of certain syrphid flies devour aphids by the hundreds to some extent in every garden. Unfortunately, in most cases, the natural balance is tipped in favor of the aphid. The natural control insects frequently fall prey to the sprays aimed at killing an aphid population, becoming one more good argument for the use of injected or root-fed systemic insecticides. ◆

(*Editor's Note*: See article on page 46.)

MELONS — 100 Years Ago

Reprinted from THE HORTICULTURIST AND JOURNAL OF RURAL ART AND RURAL TASTE, April 1870

THE CASSABA is a new variety introduced by the Department of Agriculture, and yet not generally known. A correspondent of the Department writing from Chico, California, in relation to his experiments with seeds, states that "several varieties of the cantaloupe seed produced melons which the world cannot surpass, the Japan White Cantaloupe, the Cassaba Cantaloupe and the Phinney's Early water melon being particularly fine. The Cassaba, imported from Smyrna, produced the finest melons ever grown on this continent, being as far superior to the choice Hunter melon as the latter is to the common musk melon. The whole appropriation made by Congress for your Department is repaid by the introduction of this one excellent variety of melon."

A new tool for the home gardener

Controlling Pests with Systemics

Wilbur H. Youngman

Condensed from The AMERICAN HORTICULTURAL Magazine, Winter 1969.

THE USE of modern-day systemics in plants is a new development of far-reaching importance to gardeners. Systemics are chemical compounds that may be absorbed through the leaves, bark, or roots, and translocated by the sap stream throughout the plant in sufficient quantity to destroy insects and/or disease. Systemics are far more effective than contact sprays. The latter control diseases and insects but they are effective only at the point of exterior application.

So far, only a few systemic insecticides have been formulated to work in some kinds of plants. Also, research is currently underway to find a systemic fungicide for control of plant diseases.

The importance of systemics for the home gardener:

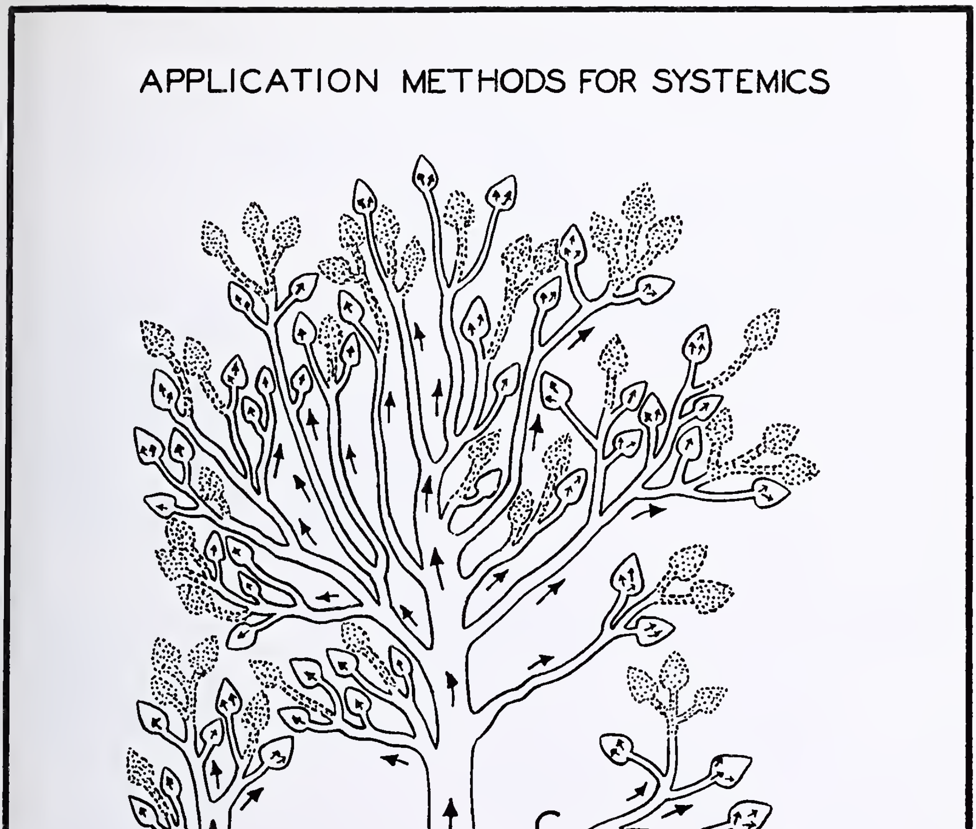
- For control of pests on trees too large for the home type of spray equipment. Systemic control of pests would be possible in a large tree at a nominal cost, as compared with the higher cost of a commercial operator.
- Systemics persist in the plant for an extended period of time and are not affected by weather: in comparison, contact sprays require several applications to be effective, because of being washed away by summer showers. It should be noted that the chemical nature of the sap may alter or modify the action of systemics. In other words, the systemic may give protection in some plants for a considerable length of time, but in other plants it may be effective for only a week or two.
- Systemics do not harm many beneficial predatory insects. This is a most desirable advantage over regular spray programs which normally kill a great many beneficial insects, such as ladybird beetles and preying mantids.
- Systemics are particularly helpful in controlling leaf miners, borers, and related pests difficult to control. With conventional contact sprays, leaf miners in holly (*Ilex*) and boxwood (*Buxus*) are difficult to control effectively because it is difficult to coincide time of spraying with emergence of the insect pest. By comparison, a systemic once applied is available at all stages in the life cycle of the insect.

Those who have had to spray for spider mites, laceflies, and other sucking insects on bushy shrubs, such as boxwood and azalea, know the difficulties of doing a thorough job with the standard contact sprays, even after several applications. Moreover, most of the materials used in fighting these pests kill only adults and do not affect either the nymphs or the eggs. Thus it takes at least three sprayings to give a reasonable degree of control. Normally, a single application of a systemic should provide full control of these insects.

One of the major problems in systemic research has been to find noninjurious compounds that could be translocated in the sap stream reasonably quickly and still be retained in sufficient concentration to kill insects. This problem has been particularly difficult to overcome. The solubility of the chemical particles and their forms influence the distribution in the plant. Also, the normal tendency is for the sap to carry the chemicals up in the sapwood into the newer rather than the older growth. These properties determine the effective useful period of a systemic chemical. However, any new growth that occurs subsequent to the spraying is unprotected.

It was soon discovered that the sap has a marked influence on the systemic mate-

(*Continued*)


APPLICATION METHODS FOR SYSTEMICS
B
A
C
A
A
protection dispersal
subsequent new growth (unprotected)

Application methods for systemics. A: Solutions or granules soaked or cultivated into soil; B: Solution applied on the bark or stem; C: Solution sprayed on foliage. Arrows indicate areas of dispersal and protection. Dotted lines show subsequent new growth (unprotected).

Drawing by Eva Melady after L. N. Meyer

GUIDE FOR USE OF SYSTEMICS ON ORNAMENTAL PLANTS
Dimethoate (CYGON 2E)

Ornamental Plants	*Pest Controlled*	*Amount per ½ Gal. Water Dimethoate Insecticide*
Azaleas (Outdoor grown)	Lace bugs, Leaf miners, Mites, Tea scale, Whiteflies	1 teaspoon
Camellia	Aphids, Camellia scale, Mites, Tea scale	1 teaspoon *Foliar Spray:* Apply 2 sprays 6 weeks apart the first year followed by annual applications soon after first growth begins in the spring. *Soil Drench:* Apply Cygon 2E Insecticide as a soil drench around the base of plants in early spring at rate of 4 tablespoons per gallon of water per plant up to 6 ft. tall. Increase this rate proportionately for larger plants.
Carnations (*Dianthus*)	Aphids, Thrips, Mites	1 teaspoon *Soil Drench:* Apply as a soil drench at the rate of 4 fluid ounces per 500 sq. ft. of bed or bench (5 qts. per ½ acre) in sufficient water for even distribution. Water thoroughly after application.
Cypress (*Cupressus* spp.)	Bacteria moth larvae	1 teaspoon Apply as a drenching spray.
Daylilies (*Hemerocallis*)	Aphid, Thrips	2 teaspoons
Roses (Outdoor grown)	Aphid, Leafhoppers, Mites, Thrips	1 teaspoon
Arborvitae (*Thuja* spp.)	Aphids, Bagworms, Mites	1 teaspoon
Birch (*Betula* spp.)	Aphids, Leaf miners	½ teaspoon For leaf miners, apply when leaves are expanded (about mid-May) and repeat in early July.
Boxwood (*Buxus* spp.)	Leaf miners, Mealybugs, Mites	1 teaspoon For leaf miners, apply in spring when leaf miner flies first appear, or in early summer for control of larvae in the infested leaves.
Cedar (*Cedrus* spp.)	Mites	2 teaspoons
Euonymus spp.	Aphids, Scale	2 teaspoons
Gardenia spp.	Tea scale, Whiteflies	1 teaspoon
Gerbera spp.	Thrips	1 teaspoon
Gladiolus spp.	Aphids, Thrips	1 teaspoon

Ornamental Plants	*Pest Controlled*	*Amount per ½ Gal. Water Dimethoate Insecticide*
Iris spp.	Aphids, Iris borer, Thrips	2 teaspoons For borer control, spray when new leaves are 5–6 inches tall.
Holly: English (*Ilex aquifolium*) American (*I. opaca*) Chinese (*I. cornuta*) but *not* Burford (*I. cornuta* 'Burford')	Leaf miners, Mites, Soft scale	1 teaspoon For leaf miners, apply in spring when leaf miner flies first appear or in early summer for control of larvae in infested leaves.
Hemlock (*Tsuga* spp.)	Mites, Scale	2 teaspoons
Juniper *Juniperus* spp.	Aphids, Bagworms, Midges, Mites	2 teaspoons
Oak (*Quercus* spp.)	Golden oak scale	2 teaspoons
Pine (*Pinus* spp.)	Aphids, Bagworms, European pine shoot moth. Nantucket pine tip moth, Zimmerman pine moth	2 teaspoons
Yew (*Taxus*)	Fletcher scale, Mealy bugs, Mites	2 teaspoons

Recommendations for di-syston, meta-systox R, and systox approved for home garden use do not carry as much detailed information as for dimethoate. However, we do have the approved list of insects which they will control as well as the recommended dosages. Directions are available on the label.

DI-SYSTON

Di-syston may be used to control the following pests on ornamentals: aphids, birch leaf miner, Colorado potato beetle, flea beetle, Hessian fly, lace bug, leafhoppers, leaf miners, mealybug, Mexican bean beetle, mimosa webworm, mites, pine tip moth, potato psyllid, root maggot, root worms, southern potato wireworm, thrips, and whiteflies.

The material approved is a 2 percent granular, and it should be used at the rate of 1 ounce per foot of height of treated plant. If necessary, it may be repeated at six week intervals.

META-SYSTOX R

Meta-systox R may be used to control the following on ornamentals: aphids, birch leaf miner, holly leaf miner, leafhoppers, mites, thrips, and whiteflies.

The material approved is a 5 percent granular and should be used at the rate of 1 tablespoonful per 4 square feet of area. This should be applied as a band over the row or worked into the soil about the shrubs. It should be cultivated into the soil and watered thoroughly.

SYSTOX

Systox may be used to control the following: aphids, foliar nematodes, holly scale, lace bugs, leafhoppers, leaf miners, mealybugs, mites, rhododendron scale, soft brown scale, tea scale, unspotted tentiform leaf miner, and whiteflies.

Available as a 2 percent granular material. Follow label as to dosage and precautions. This material should not be used less than 5 days before hand picking, transplanting or other hand work which will bring the gardener into contact with the plants.

It is important in using these materials that they be watered into the soil, that contact is not made with sprayed foliage until after it is dry.

(*Continued from page* 46)

rial. In some cases the chemical is broken down into new forms which are more toxic in the plant. Sometimes sap alters the chemicals of the systemic material. For example, the systemic called *dimethoate* provides nearly season-long control of sucking insects in azaleas, but in roses, it gives protection for only slightly more than a week.

Many systemics have been formulated in recent years but few are available that are safe for the home gardener.

Systemics recommended here as safe for home use are *dimethoate* (Cygon), *disulfoton* (Di-syston), *demeton* (Systox), and *meta-systox R.*

Dimethoate affords excellent control of many insect pests on some of our ornamentals. It is registered for sale to the home gardener because of its comparatively low toxicity. Recently, *dimethoate* was approved for use on several commercial vegetable crops, also on apple and pear trees in the first and second "cover" sprays.

While *disulfoton, demeton,* and *oxydemetonmethyl* are rated as highly toxic, formulations are available that, while toxic, *may be used but must be used with great care by the home gardener.*

To use systemics effectively, the home gardener needs to know the kinds, how to apply them, and methods of control for the various kinds of plants—trees, shrubs, and flowers. (See guide for home use of systemics, pages 48 and 49.

People in pesticide regulatory work and in research are busy trying to find the best way to use systemics, the insects they will control, and other safeguards necessary to comply with state and federal regulations. Since these steps delay the release or approval of some kinds of systemic materials, some gardeners are inclined to do a little experimenting on their own. Sometimes circumstances force people to seek an answer to practical problems. For example, dimethoate will control borers in white Florida dogwood. A band of *dimethoate* painted on the bark is effective in controlling aphids on large trees of tulip poplar (*Liriodendron tulipifera*) to prevent the shower of honeydew on objects below. Yet neither of these uses has been approved by the regulatory agencies. It is doubtful that *dimethoate* will be approved for tulip poplar, since the manufacturers are not likely to spend the money to have this use approved. Consideration should be given to provide adequate protection to people and pets who might come into contact with *dimethoate* before it is completely absorbed into the bark.

In another example, a wholesale nurseryman was confronted with rather heavy losses of birch trees infested with bronze birch borer. It was too expensive to pull and burn them, and the annual spread to other trees caused serious losses. The nursery manager recalled seeing a bulletin published by the Canadian Department of Agriculture advising the painting of bands of undiluted *dimethoate* on the trunks of young birch trees. Since starting this protective program, the birch trees have suffered no further trouble with the bronze birch borer.

We have other examples of the effectiveness of systemics for the home gardener and commercial producer. *Disyston,* for example, applied in the furrow before the planting of lily bulbs protects the plants from sucking insects that spread serious diseases through the flowering period. In Ghana where mealy bugs are a serious pest on cacao trees, capsules of the systemic *dimefox,* buried in the soil, prove an effective control of this pest.

Systemic chemicals may be absorbed through (1) leaves (2) bark, and (3) roots. Generally speaking, foliage spray is preferable since there is very little loss of material compared to soil application. However, when spraying there is always danger to the operator and to others. Extreme caution should prevail to prevent any contact of the chemical with the skin. For this reason, bark and root application is advisable.

The home gardener has good reason for an interest in systemic insecticides. *Dimethoate* has simplified control of iris borer and euonymus scale. ◆

Controlling Poison-ivy Around the Home

Reprinted from THE AMERICAN HORTICULTURAL Magazine, Spring 1969.

FEW PEOPLE have escaped the skin-blistering effects of contact with poison-ivy (*Rhus radicans*). Though we generally use considerable care in our ramblings in the woods and gardens, we are often unknowingly exposed to it.

Poison-ivy grows as a woody twining vine on trees, as a tall shrub 3 to 4 feet high, and as a low-growing shrub 1 to 2 feet tall. In general, twining and low-growing forms are found in densely shaded areas. The large shrub forms usually occur in slightly shaded or open areas. Poison-ivy has alternate trifoliate leaves. Leaflets may be smooth-margined or variously toothed or notched among the several subspecies. Clusters of small, white, waxy, berrylike fruits are formed in the leaf axils. Birds carry the seeds to uninfested areas, and established plants spread by creeping rootstocks. It grows well in many locations, including perennial ornamental plantings, parks, camping areas, sand dunes near the seashore and even in fairly boggy soil. The various forms of poison-ivy are widely distributed over the United States, with the exception of the extreme Southwest.

Poisoning occurs when crushed leaves or broken stems come in contact with the bare skin. An intense itching and formation of blisters follows within a few hours. The defoliated stems, handled mistakenly as other brush in fall or early spring, often cause poisoning. Poison-ivy seedlings grow unnoticed among woody ornamentals until they emerge through the covering foliage. Severe cases have been reported of poisoning from contact with the smoke from poison-ivy plants burned with other brush. Animals do not appear to be affected, but some cases of poisoning of humans have been tentatively traced to contact with pets that were previously exposed to poison-ivy foliage.

Prevention of poisoning of even the most sensitive person is possible. First, avoid it by knowing the plant. Study descriptions and photographs. Remember our childhood warning, "Leaflets three, let it be." Second, if you must handle poison-ivy, wear heavy rubber or leather gloves that can be thrown away. Avoid contact with contaminated clothing or tools. Finally, eradicate the plants.

Poison-ivy cannot be satisfactorily controlled by handpulling, grubbing, or mowing. Many roots are overlooked in grubbing, and repeated mowing is a temporary remedy. Repeated exposure to the plants in these manual operations is a real hazard. Fortunately there are herbicides that will safely and effectively control poison-ivy in practically any area. Carefully directed sprays of amitrole, also available under the name aminotriazole, can be used in wooded areas around the home and in woody ornamental plantings. Spray only during calm weather. Use low pressure and a metal or cardboard shield to protect valuable plants. Where poison-ivy is growing among ornamentals, it may be necessary to apply the herbicides with a small sponge nailed to a wooden handle to prevent injury to the ornamentals. These herbicides move from the foliage to all parts of the plant and thus kill the roots as well as the tops.

In large wooded areas or parks and lawns 2, 4, 5-T (2,4, 5-trichlorophenoxyacetic acid) will kill poison-ivy without injury to desirable plants if sprays are carefully directed.

All chemicals described in this report should be applied in accordance with the directions on the manufacturer's label as registered under the Federal Insecticide, Fungicide, and Rodenticide Act. ◆

Site of experimental planting of grasses at 1,850 feet above sea level.

Reclaiming Wasteland In Iceland

Sturla Fridriksson

Adapted and condensed from the original report in the JOURNAL OF AGRICULTURAL RESEARCH of Iceland, 1969.

ORDINARILY almost nothing grows in the highland range country of central Iceland. To test the possibility of establishing vegetation on this uninviting, barren glacial outwash and pumice, several different sites were chosen at elevations of from approximately 1,800 to 2,100 feet above sea level. These were north of the Tungnaá River, at different distances from the great 3,000 square mile snowfield of Vatnajökull.

Three pasture grasses (red fescue, timothy and meadow foxtail) were sown on the glacial outwash and pumice, in individual 2½ acre plots. They were fertilized each year for 3 years at the per acre rate of 267 pounds of ammonium nitrate, 223 pounds of triple superphosphate and 44 pounds of potassium chloride.

After sowing and three years' fertilization a dense turf grew on this pumice, where vegetation had hitherto been very scant. The red fescue turf was particularly dense, and the yield of hay at these higher elevations was similar to that obtained in soil at lower elevations. From the ecological point of view it should be easy to cultivate these wastelands by sowing grasses and fertilizing. ◆

Above: Seed plot with red fescue grass *(Festuca rubra)* during first summer. *Below.* Same area, second summer. Red fescue produced densest turf.

Birds and Seed Dispersal over Long Distances

Sturla Fridriksson and Haraldur Sigurdsson

Condensed from NATTURUFRAEDINGURIN, Reykjavik, 1969

DISTANT ISLANDS must to a great extent owe their plant and animal life to long distance dispersal of living material. The role played by birds has long been in dispute among biologists.

The almost sterile habitat of the new volcanic island of Surtsey offers a unique opportunity to study the possible role of birds in transporting plants and lower animals across wide stretches of ocean. Surtsey, being the southernmost dryland of Iceland, might become the first landing place for migratory birds arriving in the spring from European countries. Thus migration of birds to the island was recorded and a variety of birds were collected on Surtsey as they arrived during the period March 31 to May 12, 1967.

The birds caught were identified, sexed, and weighed. They were then closely examined for any possible seeds or other organisms which might be attached to the exterior of the body, after which the birds were dissected and their alimentary tract cleaned of content. If there were seeds present they were identified and tested for germination. Finally the grit from the gizzard was inspected, as minerals or rock types might reveal where the last intake of food occurred.

From the total number of 97 birds of 14 different species, none of the birds carried seed on their exterior. A few birds carried nematodes and other parasites. Of the total birds caught 32 were snow buntings of the nominate race which differs from the Icelandic race. Of these, ten individuals had seeds in addition to grit in their gizzards. The ten birds carried with them 87 seeds, the majority of which seemed viable. Plants from two were grown to maturity (*Polygonum persicaria* and *Carex fusca*).

The records indicate that only the snow buntings of a nominate race were seed carriers. That the seeds were in the gizzard and none in the stomach indicates that the birds had not been caught feeding but apparently consumed the seeds at an earlier time. The accompanying rocks and minerals definitely show that the birds had not been on the mainland of Iceland, i.e., there was no old Icelandic basalt in the gizzards. On the other hand, there were grains of cinder picked up in Surtsey and rock types and younger sediments which must have been collected by the birds outside Iceland.

Most of the seeds identified from the gizzards. were of species rather common both to Iceland and the British Isles, such as crowberry (*Empetrum*), a rush (*Scirpus*) and a member of the pink family (*Spergula*), as well as the sedge *Carex fusca;* also *Polygonum persicaria,* a European species, which only survives in Iceland around cultivated areas.

One seed was identified as bog-rosemary (*Andromeda polifolia*). This plant is definitely not found growing in Iceland, but is native to Greenland as well as the British Isles, where it is found in bogs from Somerset to the Hebrides. A few seeds are with hesitation identified as those of alfalfa (*Medicago sativa*). If this is correct, it would almost eliminate both Greenland and Iceland from being the place of origin of the seeds. It is concluded that the seed in the gizzards of the snow buntings, together with the mineral grit, were either picked up by the birds in the British Isles and carried by them over the ocean to Surtsey on their migration to Greenland via Iceland, or picked up in Surtsey with the Surtsey ash. Should the former statement be true, it would prove that birds transport seed over long distances and some seeds retain viability. ◆

The oldest living thing—

The Bristlecone Pine

Ralph D. Cornell

Reprinted from TREES Magazine, November-December 1968

ALTHOUGH unsuited for use as street trees or as trees for the garden, the bristlecone pines (*Pinus aristata*) are one of the most notable and unusual trees in America. They occur principally in scattered spots within Colorado, Utah, Nevada and California but never in large forest stands or quantities as pine trees grow. They are trees for the high altitudes, beginning where most trees give up in discouragement with the ecological environment of thin air, xerophytic conditions, poor soil and extremely cold winters.

It is likely that a bristlecone pine never got as low in this world as 9000 feet above sea level under natural circumstances. It occurs chiefly between the elevations of 10,000 and 12,000 feet, in scattered clumps and groves that follow the limestone outcrops to provide a root zone that is slightly alkaline.

Probably the most spectacular and surely the most accessible stands of these trees are found on the east face of White Mountain of the Inyo-Kern Range in California above the 10,000-foot level. Rainfall of this area averages about 10 inches a year. Winter cold is severe with icy winds that whip sleet and gravel through the air with the cutting velocity of a sand blaster. Within this environment the bristlecones stand gaunt and firm, without companion trees or undercover plants, as they lift their arms toward the domed skies that tower above them.

And the most interesting thing about them perhaps, is that they are the oldest living things, known today, on the face of the earth—going back at least 1500 years before the beginning of the oldest sequoia tree to have been authenticated at this time. Ages of ancient trees are determined by core borings which make it possible to count the annual rings of growth which a tree has made, one ring for each year of life. Thus ages are precise, not speculative. The oldest known sequoia is about 3200 years old. Age of the oldest bristlecone pine has been authenticated at about 4700 years. Older trees of either species may yet be found.

There are dead skeltons of this remarkable tree that have stood for 1000 years since death, as proven by their core borings. Even in death they thus "live" on for centuries in sculptural testimony to the remarkable forces of nature.

Many of the older trees are fire scarred with stiff, rigid and bleached branches that lift skyward toward the blue dome that sometimes seems almost black at such altitude. From the base or sides of the whitened, skeletal trunks comes new growth that continues the life of the individual tree for perhaps centuries or millennia after all but a thin strip of living cambium survived the tortures of fire. Tenacity to life seems almost to be undaunted as growth slowly expands from the flimsiest of living tissue into masses of green foliage and branches on which bristle cones continue to appear and set seed as the centuries roll on. Actually these trees grow so slowly, however, that a hundred years of struggle may add no more than an inch to the diameter of a trunk: one hundred years to expand the trunk another inch in thickness.

Nature never is in a hurry and, in this case, growth is exceedingly fine. Density of the wood is such that it is very difficult to cut or saw. It is unusually heavy and, before the discovery of the trees' antiquity and their subsequent protection, these noble pines were used for firewood by those sufficiently impelled to seek them out in their wilderness locations. Now they are protected on all but some small holdings of private land.

The largest (but not the oldest) of the trees in the White Mountain area has a trunk circumference of something over 36 feet, about 30 or 40 feet high. It, too, has its bleached branches scarred by fires which likely were caused by lightning. For anything which has stood for thousands of years, projecting upward from a rounded mountain top at high elevations, must have been struck by lightning many times. As to running forest fires, it is unlikely that such a spreading blaze could be maintained in the sparse vegetation of the habitat site.

The oldest tree is not the largest tree and it would seem that the oldest trees are the ones which have had the hardest struggle for existence. Growing even more slowly than average, their wood is more dense, heavier and probably more resistant to the ravages of insects, mold and rot. Thus with adversity, comes strength.

These remarkable trees have stood in their mountain fastness for a very long time. Old trees are interspersed with tiny seedlings that range in all sizes and conditions from the smallest to the patriarchs. They obviously are maintaining their balance of vitality in the mosaic of high-altitude environment that constitutes their habitat. Some trees of from six to eight feet in height may be several hundred years old but still look very young and vigorous. Seemingly, the bristlecone pine shall continue to be with us for a very long time. ◆

Dawn-redwood Produces Staminate Cones ("Male Flowers") in Williamsburg, Virginia

Reprinted from AMERICAN HORTICULTURAL MAGAZINE, Summer 1969

IN JUNE 1948, I visited the Jardin Botanique de l'Etat in Brussels and saw in a greenhouse there many seedlings of *Metasequoia glyptostroboides,* grown from seed distributed by the Arnold Arboretum. I sent a small packet of the same lot of seed by airmail to Dr. Bernice M. Speese at the College of William and Mary, Williamsburg, Virginia, and she planted them immediately. Germination was in a matter of days. We might well date the seedlings from July 1, 1948.

Five of the young plants were established on the grounds of the College and another given to a resident of the city. They all thrived. Later, however, two big individuals had to be moved; growth of one of the trees was seriously retarded. My recollection is that these six trees have produced female cones for at least ten years. Dr. Speese harvested 1968 seed from which she has a number of vigorous seedlings.

Data on two of our trees are recorded via photographs made by Col. Donald W. Noake on March 25, 1969. One of the photographs shows trees with heights of 57 and 69.3 feet respectively and with corresponding girths of 10.3 and ca. 9.5 feet at ground level. The picturesque bases are buttressed and fluted. Another photograph was taken of a branch with the male and female cones. Dr. Kenneth F. Bick determined the heights of the trees.

These are among the largest representatives of dawn-redwood in cultivation; they are likewise among the first to have male cones and to produce viable seed.—*J. T. Baldwin, Jr.*

Seeds available to members of the Brooklyn Botanic Garden

Unusual Trees and Shrubs

A LIMITED quantity of seed of the rare or unusual trees and shrubs in this list is available to Brooklyn Botanic Garden members in the spring of 1970. Inquiries should be addressed to Mr. Frederick McGourty, Jr., Brooklyn Botanic Garden, 1000 Washington Avenue, Brooklyn, New York 11225. Please enclose a stamped, self-addressed envelope. Seed requests that cannot be filled now will be held until the autumn 1970 crop matures. (Information on membership in the Garden, $10.00 annually, is available from Mrs. Norman Free, in care of the above address.)

Idesia ***(Idesia polycarpa)*** A rare medium-sized tree from eastern Asia, at its best in autumn when laden with 8-inch long, drooping panicles of red berries. The leaves are catalpa-like but smaller and less coarse, while the bark of this rapidly growing tree is grayish-white, resembling aspen or American holly. The yellowish-green flowers that appear in spring are fragrant but inconspicuous.

The original idesia trees came to the Garden in 1925 from the Yokahama Nursery Company of Japan. Planted near the brook that meanders through the center of the Garden, they died to the ground the first several winters, but are now about 40 feet tall. At the Garden the sexes of idesia, like holly, have been borne on separate trees. Only the pistillate ("female") tree bears fruit but the staminate ("male") tree is needed for pollination. Hence, several trees should be grown until the sexes can be determined. Idesia is probably not winter hardy where temperatures fall below zero degrees Fahrenheit for extended periods.

Golden-chain ***(Laburnum anagyroides)*** A large shrub or small tree growing ultimately to 15 or 20 feet, native to southern Europe. The pendulous flower clusters, which appear in mid-May in New York City, resemble wisteria blossoms, but they are yellow instead of violet. Best grown in full sun in soil that is not overly acid. Hardy to about —5 F. Golden-chain seeds available for distribution are a gift of Mrs. Berton J. Delmhorst of Stonington, Connecticut.

Blue-flowered sophora ***(Sophora davidii)*** A seldom planted shrub from the plains of western China and river valleys near the Tibetan border, growing eventually to 5 or 6 feet. The profuse bluish-white pea-like flowers appear in early June at the Botanic Garden, and the fine-textured leaves are attractive all summer. Best growth is likely to occur in full sun in somewhat dry soil of average fertility. Hardy where winter temperatures do not drop below —10 F.

Chinese scholar-tree ***(Sophora japonica)*** A splendid eventually tall-growing tree with leaves resembling those of the black locust. The great charm of this tree is its vase shape, reminiscent of the American elm. Conspicuous white pea-like flowers appear in mid- to late summer when few other trees are in bloom. It is one of the ten finest trees in the Garden. Although *Sophora japonica* may suffer minor twig damage in a very severe winter in New York City, it is winter hardy to at least the Berkshire Hills of western Massachusetts, where temperatures regularly drop to —15 F. or lower.

Chinese pepper-bush ***(Zanthoxylum simulans)*** A graceful, tall, spreading shrub or small tree attractive in all seasons. Splendid winter effect with flattened spines extending down the trunk. Best in autumn when the leathery-red fruits ripen. The small white flowers of this citrus relative are attractive in late spring. Chinese pepper-bush always retained good foliage in the prolonged northeastern drought of recent years. The Botanic Garden's original plant came from the U.S. Department of Agriculture in 1934. Probably not reliably hardy where winter temperatures fall below —5 F. for long periods. ◆ *F. McG.*

1969 BOOKS WORTH NOTING

In the Library of the Brooklyn Botanic Garden

BOTANICAL GARDENS

Great Botanical Gardens of the World by Edward Hyams. The Macmillan Company, New York. Illustrations in color and in black and white. 288 pages. $35

Big, lavish, handsomely illustrated. A book for browsing rather than a concise, thorough guide. Of value are the maps which accompany each of the botanical gardens featured. They show locations of plant collections and special gardens of interest to visitors.

FLOWER ARRANGEMENT

Interpretive Flower Arrangement by Nelda H. Brandenburger. Hearthside Press, N. Y. Illustrated. 157 pages. $6.95

How to show personal expression with plant materials in designs to fit moods, holidays and seasons. 8 of the 111 pictures are in full color.

A New World of Flower Arrangement: Designs for Our Times by Patricia Kroh. Doubleday and Company, New York. Illustrated. 160 pages. $7.95

Abstract emphasis in flower arrangement. Also sections on photographing flower arrangements, conditioning and reviving flowers and foliage.

Flower Growing for Flower Arrangement by Arno and Irene Nehrling. Hearthside Press, N. Y. 228 pages. $5.95

Handbook on forcing for early blooms, conditioning and drying plant materials.

Fun with Flowers by Martha and Marvin Neese. Walter and Company, New York. Illustrated. 111 pages. $5.95

Japanese flower arranging in simple, how-to fashion with drawings and diagrams.

Floral Art for Religious Events by Leon J. Tolle, Jr. Hearthside Press, N. Y. 192 pages, 24 color plates and numerous black and white photographs. $8.95

Manual of tradition and designs for worship, weddings, funerals and other events.

Miniature Flower Arrangements and Plantings by Lois Wilson. Hawthorn Books, N. Y. Illustrated. $6.95

A treasure house of ideas for everyone whose interests lie in miniatures.

MISCELLANY

Garden Blocks for Urban America by Louise Bush-Brown. Charles Scribner's Sons, New York. 126 pages, 12 full color photographs and 30 black and white. $10

Account of Neighborhood Association of Philadelphia and its successful efforts in establishing over 500 "garden blocks" and influencing the lives of some 200,000 people—a heartening example for uplifting depressed city neighborhoods.

Using Wayside Plants by Nelson Coon. Hearthside Press. Illustrated. 288 pages. $5.95

Enlarged edition of a popular book.

Garbage As You Like It by Jerome Goldstein. Rodale Books, Emmaus, Pa. 243 pages. $4.95

Subjects related to waste disposal.

Shakespeare's Flowers by Jessica Kerr, illust. by Anne O. Dowden. 85 pages, more than 30 illustrations in full color. Thomas Y. Crowell Company, N. Y. $5.95

After-dinner Gardening Book by Richard W. Langer. The Macmillan Company, N. Y. Illustrated. 198 pages. $4.95

Slight yet amusing account of city couple's efforts in growing such dinner dregs as mango pit, avocado and others.

FORESTRY

Bernhard Eduard Fernow—A Story of American Forestry by Andrew Denny Rodgers III. Hafner, N. Y. 623 pages. $11

Biography of first professional forester in North America as well as history of American forestry from 1870 when we supposedly stopped assuming that the continent's forest reserves were inexhaustible.

GARDENING IN GENERAL

The Complete Illustrated Book of Garden Magic by Roy E. Biles. Completely revised and edited by Marjorie J. Dietz. J. G. Ferguson Publishing Company, Chicago, Illinois and Doubleday and Company, N. Y. 403 pages, 32 full page color photographs and 391 black and white; 170 step-by-step line drawings. $9.95

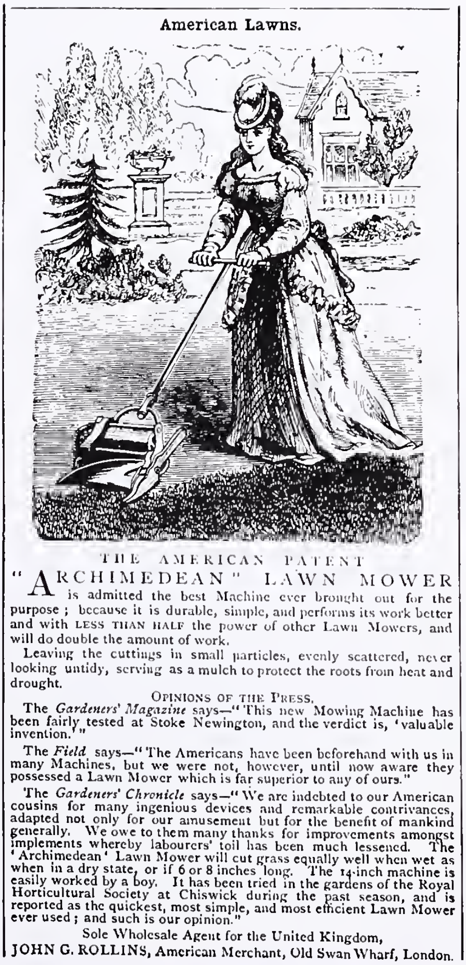
General gardening book well illustrated with both photographs and drawings.

Greenhorn's Guide to Gardening by D. X. Fenten. Grosset and Dunlap, New York. Illustrated. 246 pages. $5.95. Beginners manual on planning, tools, soils, lawns, trees, shrubs, etc.

The Happy Gardener by J. L. V. Fletcher. Funk and Wagnalls, New York 123 pages. $3.95

"Eat cress to learn more wit." "Love thy neighbor but pull not down thy hedge." "Straight trees have crooked roots." And more.

FOR SALE *100 years ago . . . Gardener's Chronicle & Agricultural Gazette*



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OPINIONS OF THE PRESS.

The *Gardeners' Magazine* says—"This new Mowing Machine has been fairly tested at Stoke Newington, and the verdict is, 'valuable invention.'"

The *Field* says—"The Americans have been beforehand with us in many Machines, but we were not, however, until now aware they possessed a Lawn Mower which is far superior to any of ours."

The *Gardeners' Chronicle* says—"We are indebted to our American cousins for many ingenious devices and remarkable contrivances, adapted not only for our amusement but for the benefit of mankind generally. We owe to them many thanks for improvements amongst implements whereby labourers' toil has been much lessened. The 'Archimedean' Lawn Mower will cut grass equally well when wet as when in a dry state, or if 6 or 8 inches long. The 14-inch machine is easily worked by a boy. It has been tried in the gardens of the Royal Horticultural Society at Chiswick during the past season, and is reported as the quickest, most simple, and most efficient Lawn Mower ever used; and such is our opinion."

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W. RICHARDSON AND Co., Horticultural Builders, Darlington.

The Know-Nothing Gardener's Guide to Success by George F. Hull. Hawthorn Books, New York. Illustrated. 184 pages. $5.95

Down-to-earth guidance for the novice.

Informal Gardening: The New Homeowner's Guide to Planting His Property by B. Cory Kilvert, Jr. Illustrated. The Macmillan Company, New York. 246 pages. $5.95

Really a two-part book, first involved with buying land, handling the land while the house is being built and, second, evolving a naturalistic garden and landscape, which take full advantage of the property's original ecology. The account is based on the author's own experiences. Common sense conservation.

On Gardens and Gardening by Lanning Roper. 240 pages, 153 illustrations of which 16 are in full color. Harper and Row, N. Y. $15.00

Chapters on the making of gardens and garden miscellany, trees and shrubs, flowering shrubs, climbers, herbaceous plants and borders, water-gardens and bog plants, town gardens and six other important headings. While written primarily for the English reader, the book offers numerous ideas for American gardeners.

The Country Garden by Josephine Nuese. 256 pages, 51 black and white photographs. Charles Scribner's Sons, N. Y. (1970). $7.95

A chapter for each month of the year for people with small to large properties who live in or near real country, especially in climate zones 5 and 6.

Supplement—Dictionary of Gardening edited by Patrick M. Synge. Oxford University Press, London. $15

First supplement since 1956. It has 555 pages and while it is intended mainly to bring the esteemed *Dictionary of Gardening* up-to-date, it is a worthy encyclopedia in itself.

The Pocket Encyclopedia of Roses by H. Edland. Macmillan, N. Y. 208 pages. $4.95

Primarily for rose growers in England; limited information on culture for U.S.A. 507 popular roses in full color with brief descriptive information on each.

A Perfect Lawn the Easy Way by Paul N. Voykin. Rand McNally, Chicago. 124 pages. Paperback edition, $1.95; cloth, $$3.95

Lawn maintenance from point of view of a golf course superintendent.

SPECIAL GARDENS

Early American Gardens by Ann Leighton. Houghton Mifflin Company, Boston, Massachusetts. Illustrated. 441 pages. $10

Fairly lively—as well as documented—account of 17th-century gardens and the plants that sustained the earliest settlers in North America.

The Complete Book of Patio Gardening by Jack Kramer. G. P. Putnam's Sons, New York. Illustrated. $6.95

Designing, building and planting a patio. Excellent drawings and diagrams as well as photographs.

Patios, Terraces and Roof Gardens by Alice Upham Smith. Hawthorn Books, Inc., New York. Illustrated with diagrams and photographs. 179 pages. $8.95

Practical and contemporary, with much useful information. Imaginative designs for many situations.

GREENHOUSE AND INDOORS

1000 Beautiful House Plants and How to Grow Them by Jack Kramer. William Morrow and Company, N. Y. Illustrated. $12.95

A wealth of information for indoor gardeners.

Gardens Under Glass by Jack Kramer. Simon and Schuster, N. Y. Illustrated. $4.95

Miniature greenhouse ideas for bottles, bowls or dishes.

Herbs to Grow Indoors by Adelma Grenier Simmons. Hawthorn Books, N. Y. Illustrated. 146 pages. $5.95

Culture and uses. Kathleen Bourke's drawings are excellent.

Complete Book of Flowers and Plants for Interior Decoration by Esther Wheeler and Anabel Combs Lasker. Hearthside Press, N. Y.. Revised by Anabel Combs Lasker. 17 color plates, 133 black and white photographs and numerous line drawings. 206 pages. $10

Relating arrangements to furnishings and rooms. There is a new section on Garden Rooms.

Greenhouse Tomatoes by S. H. Wittwer and S. Honma. Michigan State University Press, East Lansing. 95 pages. $5.75.

Guide to successful commercial production.

LANDSCAPING

The Secrets of Artistic Gardens by Harold D. Givens. Van Nostrand-Reinhold Company, New York. Illustrated. 131 pages. $7.95

Garden planning for color with the aid of a wheel device indicating bloom season for plants with flowers of various colors.

Do's and Don'ts of Home Landscape Design by Robert J. Stoffel. Hearthside Press, N. Y. 192 pages. $6.95

A landscape architect's 92 step-by-step photos or drawings to guide the home owner, accompanied by condensed text.

English Gardens and Landscapes 1700-1750 by Christopher Hussey. Funk and Wagnalls, N. Y. Illustrated. 174 pages. $15

A scholarly history of Georgian gardens, with 246 photographs.

Florida Landscape Plants—Native and Exotic by John V. Watkins. University of Florida Press. Drawings by Marion Ruff Sheehan. 368 pages. $7.50

Of use to newcomers to Florida. The various climatic areas have been divided into three growing regions from which a Florida Zone Map has been evolved.

OUTDOOR OBSERVATIONS

Our Vanishing Wilderness by Mary Louise and Shelly Grossman and John N. Hamlet. Madison Square Press of Grosset and Dunlap, New York. 275 photographs, 150 in full color. 324 pages. $14.95

Excellent photographs along with dramatic account of struggle to preserve reason and balance in our ecology.

Reading the Woods by Vinson Brown. 160 pages, profusely illustrated with black and white photographs and line drawings. Stackpole Books, Harrisburg, Pa. $5.95

Chapters on recognizing how climates make woods, seeing the tales of weather, effects of fire and rebirth, how animals and man fashion the woodlands, reading signposts in evergreen forests and other headings.

PLANTS FOR FOOD

The Oxford Book of Food Plants by G. B. Masefield, M. Wallis, S. G. Harrison, and illustrated by B. E. Nicholson. Oxford University Press, N. Y. 206 pages. $11

A valuable reference volume on food plants of the human race. World-wide scope. Twenty categories, from grains and exotic water plants to tropical root crops, spices, seaweed, etc. Over 400 varieties illustrated in color.

The Book of Spices by Frederic Rosengarten, Jr. 489 pages, 330 illustrations including 73 in full color. Livingston Publishing Company, Wynnewood, Pa. $20.00

Herb enthusiasts will find this book authentic, informative and attractive. Over 200 recipes are included along with the history of spices, and special treatment of 35 most important spices and herbs.

PLANT NAMES

A Manual of Plant Names by C. Chicheley Plowden. Philosphical Library, New York. 260 pages. $10

Collection of generic, specific and common designations of plants with derivations of such names—in short, scientific names explained and simplified.

SPECIAL PLANTS

The Native Cacti of California by Lyman Benson. Stanford University Press. Photographs in color and black and white. 243 pages. $7.95

Semi-popular and semi-technical treatment of both native and introduced species.

Nightshades—The Paradoxical Plants by Charles B. Heiser, Jr. W. H. Freeman and Company, San Francisco. 200 pages. $5.95

The potato, tomato, eggplant and pepper—and the petunia, but also deadly nightshade, henbane, Jimson weed and, of course, the tobacco. A popularly written book, the first of its kind on this subject.

Handbook of North American Nut Trees edited by Richard A. Jaynes. 421 pages, illustrated. $8.00

All subjects treated by professionally experienced men. Chapters on culture and propagation, 12 important species of nuts and miscellaneous related topics.

PLANTS IN PICTURES

The Color Dictionary of Flowers and Plants for Home and Garden by Roy Hay and Patrick Synge. Crown Publishers Inc., New York. Illustrated. 373 pages. $15

A large book and impressive for the American reader because it shows 2,048 plants in full color. The color reproduction is generally very good. George Kalmbacher of the Brooklyn Botanic Garden was the American consultant for the book which orginated in England.

TREES—SHRUBS—VINES

Trees by Andreas Feininger. The Viking Press, New York. 116 text pages + 160 full page photographs (40 in color). $22.50

Impassioned appreciation in text and photographs by a master photographer. Mr. Feininger looks beyond the tree—to its wood, bark, leaves, roots.

Trees in a Winter Landscape by Alice Upham Smith. Holt, Rinehart and Winston, New York. Illustrated by the author. 207 pages. $6.95

Silhouette sketches of 70 native and exotic trees for temperate climates—directed to all who are concerned with tree form and branching habit.

The Trees of Christmas by Edna Metcalfe. Abingdon Press, Nashville and New York. Photographs in color and diagrams. 188 pages. $7.95

Attractive book showing trees decorated according to Christmas customs in various countries.

Shrubs and Vines for American Gardeners by Donald Wyman. The Macmillan Company. 613 pages. $14.95

Important reference book for everyone interested in ornamental horticulture, by the highly respected Horticulturist of the Arnold Arboretum. Selections of some 1700 different kinds. Typical data given: order of bloom, tabular descriptions, hardiness zones, native habitats, date of introduction.

Rhododendrons in America by Ted Van Veen. Sweeney, Krist & Dimm, Inc., Portland, Oregon 97209. 176 pages. Over 200 color photographs. $20

An enthusiastic survey of the rhododendron from coast to coast, north and south. Foreword by David G. Leach. Cultural and landscaping information is included, but the most valuable asset is the number of large color photographs of many species and cultivars.

Soft-cover reprints by Dover Publications, N.Y.

Rocky Mountain Trees by Richard J. Preston, Jr. 3rd edition. 285 pages, $2.75

Fully illustrated with line drawings.

Our Northern Shrubs and How To Identify Them by Harriet Keeler. 539 pages, including 240 black and white illustrations. $3.75

Plant Materials of Decorative Gardening by William Trelease. 188 pages, keys. $2.00

BOTANY—TECHNICAL

Flora of Alaska and Neighboring Territories: A Manual of the Vascular Plants by Eric Hulten. Stanford University Press. Stanford, California. Illustrated. 1008 pages. $35

A career botanical undertaking by the Director Emeritus of the Museum of Natural History, Stockholm. This scholarly work has identification keys and polar projection range maps. Fully illustrated by line drawings, also 8 pages of full color photographs taken by the author.

The Plasmodiophorales by John Karling. 2nd edition, revised. 256 pages, 23 plates. Hafner Publishing Company, N. Y. $17.50

Research Methods in Plant Science by Richard M. and Deana T. Klein. 756 pages, many outline drawings and diagrams. American Museum of Natural History Press, N. Y. $20.00

A comprehensive how-to book of many objectives primarily for the professional. 13 chapters deal with topics such as acquisition and maintenance of plant collections, environmental control of plant growth, water relations and mineral nutrition, general procedures for the cultivation of plants (bacteria and fungi to higher plants, in vitro) growth factors, preparation of manuscripts, etc.

The North American Species of Pholiota by Alexander H. Smith and L. R. Hesler. 402 pages, 90 plates and 40 line drawings. Hafner Publishing Company, N. Y. $22.50

Classical Botanical Books reprinted by the Hafner Publishing Company, N.Y.

Reliquiae Baldwinianae. Compiled by William Darlington. 346 pages. $12.50

Facsimile of the original, privately published in 1843. Introduction by Joseph Ewan. Index added. Baldwin's (1779-1819) note as a botanist is based chiefly on his plant collections in the Carolinas, Georgia and Florida. Letters contain interesting comments on many prominent men of his time.

Organography of Plants by K. Goebel. Introduction by Joseph Ewan. 2 volumes. Facsimile of the original which was published 1900-1905 (vol. 1, 270 pages; vol. 2, 707 pages) $32.50

A Flora of North America by John Torrey, M.D., and Asa Gray, M.D. Introduction by Joseph Ewan. 2 volumes. Facsimile of the original which was published 1838-1843 (vol. 1, 711 pages; vol. 2, 506 pages) $45.00

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ERRATA: Handbook on CONIFERS

Please make corrections as follows:

p. 53 delete **Imperial Palace,** substitute **Diet Building**

p. 105 col. 1—4th nursery address:
delete **Coates,** substitute **Castro**

ERRATA: Handbook on FERNS

p. 44 Please delete **single-celled organisms**
from line 5 in **How a Fern Reproduces**

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

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